Status and Management of Southern Appalachian Mountain Balds

Proceedings of a Workshop
November 5-7, 1980
Crossnore, North Carolina

SOUTHERN APPALACHIAN RESEARCH/RESOURCE MANAGEMENT COOPERATIVE

STATUS AND MANAGEMENT OF SOUTHERN APPALACHIAN MOUNTAIN BALDS

edited by

Paul Richard Saunders
Assistant Professor
Department of Recreation and Park Administration
College of Forest and Recreation Resources
Clemson University

Proceedings of a Workshop

sponsored by

The Southern Appalachian Research/Resource Management Cooperative (SARRMC)

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SARRMC MEMBERS

Clemson University
National Park Service, Southern Region
Tennessee Valley Authority
U.S. Forest Service, Southeastern Forest Experiment Station
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SARRMC
School of Arts and Sciences
Western Carolina University
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THE SOUTHERN APPALACHIAN RESEARCH/RESOURCE MANAGEMENT COOPERATIVE

The Southern Appalachian Research/Resource Management Cooperative (SARRMC) was formed because of a need to involve federal agencies and universities in a continuing porgram of research and problem identification on natural resource management issues. Cooperative agreements were initially signed by Western Carolina University; The School of Forestry at North Carolina State University; the U.S. Forest Service, Southeastern Forest Experiment Station; and the National Park Service represented by the Great Smoly Mountain National Park and the Blue Ridge Parkway. As the need for additional expertise became apparent, other universities and agencies were invited to become members until the membership now includes, in addition to the four original members, Clemson University, the University of Georgia, the University of Tennessee, Virginia Polytechnic Institute and State University, the U.S. Fish and Wildlife Service, and the Tennessee Valley Authority. Policies are set for SARRMC by the Executive Committee which includes a representative from each constituent member.

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FOREWARD

In 1980 a Planning Committee under the able chairmanship of Fred Huber, representing the U.S. Forest Service, met to formulate plans for a regional workshop which would address the issue of whether the remaining Southern Appalachian Mountain Balds should in some way be managed or conserved. The Planning Committee members included John McCrone, Executive Director of the Southern Appalachian Research/Resource Management Cooperative, from Western Carolina University; Peter White, Larry Freeman,and Gary Everhardt from the National Park Service; Bob Currie of the U.S. Fish and Wildlife Service; Don Bech from the U.S. Forest Service Southeastern Forest Experiment Station; and Rema Farmer from the Appalachian Trail Conference. Funding for the committee was provided by the Southern Appalachian Research/Resource Management Cooperative (SARRMC). The workshop was held on November 5-7, 1980, in Crossnore, North Carolina.

The proceedings of this workshop were prepared from the formal papers presented, tapes and other materials collected during the meeting, notes provided by the five discussion group leaders, and the editors' notes from the general sessions. Appreciation is extended to the above people who made these materials available, and to the able assistance and direction provided by SARRMC. All errors and omissions are the responsibility of the editor.

Appreciation is extended to Judith Mitchell and Kathryn Neckerman of the Department of Recreation and Park Administration at Clemson University who typed the final manuscripts, and to Lisa Butler for the cover drawing.

March, 1981

Paul Richard Saunders
Clemson, South Carolina

EXECUTIVE SUMMARY

On November 5-7, 1980, approximately 54 scientists, resource managers, interest group representatives, and members of the public attended a workshop on the status and management of Southern Appalachian Mountain balds in Cross-nore, North Carolina. The objectives of the workshop were to (1) provide a forum for exchange of ideas, (2) thoroughly discuss the pressing issue of bald management, (3) identify short term and long term research needs related to bald management, (4) identify the management needs of resource managers, and (5) identify means of informing and involving the public in this issue.

The workshop format consisted of eight formal presentations by scientists, resource managers, and the interested public. These papers dealt with the probable origins of the balds, the aesthetics of the balds, the management of a bald area, the effects of that bald management effort, and the philosophical and resource questions of selecting balds for management and then managing those balds. Following the presentations, five discussion groups met twice each to identify research, management, and public involvement needs. During the final morning session the leaders of each group presented the results of these discussions. A general discussion was then held among all participants to identify the most crucial issues and to suggest an agenda for action.

On the basis of these discussions the following recommendations are made to SARRMC Executive Committee for their consideration:

1. The remaining bald resources must be identified, research on bald management must be conducted, and an informed public must become involved in this complex resource management issue.

2. Workshops which focus on current research, results of attempted management techniques, and identification and classification of balds should be held in the future. The workshops may be sponsored by SARRMC or held in conjunction with related meetings such as those of the Appalachian Trail Conference.

3. A technical committee composed of both managers, scientist, and the public should be formed to see that the recommended steps are initiated, and that researchers and managers are aware of the work of each other. Nominations for this committee will be solicited from those present at the workshop.

INTRODUCTION

The Southern Appalachian Mountain region is rich in unique biotic communities and characterized by rugged, steep mountains, narrow valleys, and long, high ridge tops. The region extends from western Virginia through eastern Tennessee, western North Carolina,and northeastern Georgia into northwestern South Carolina. Among the unique features of this area are "balds" (see Figure 1).

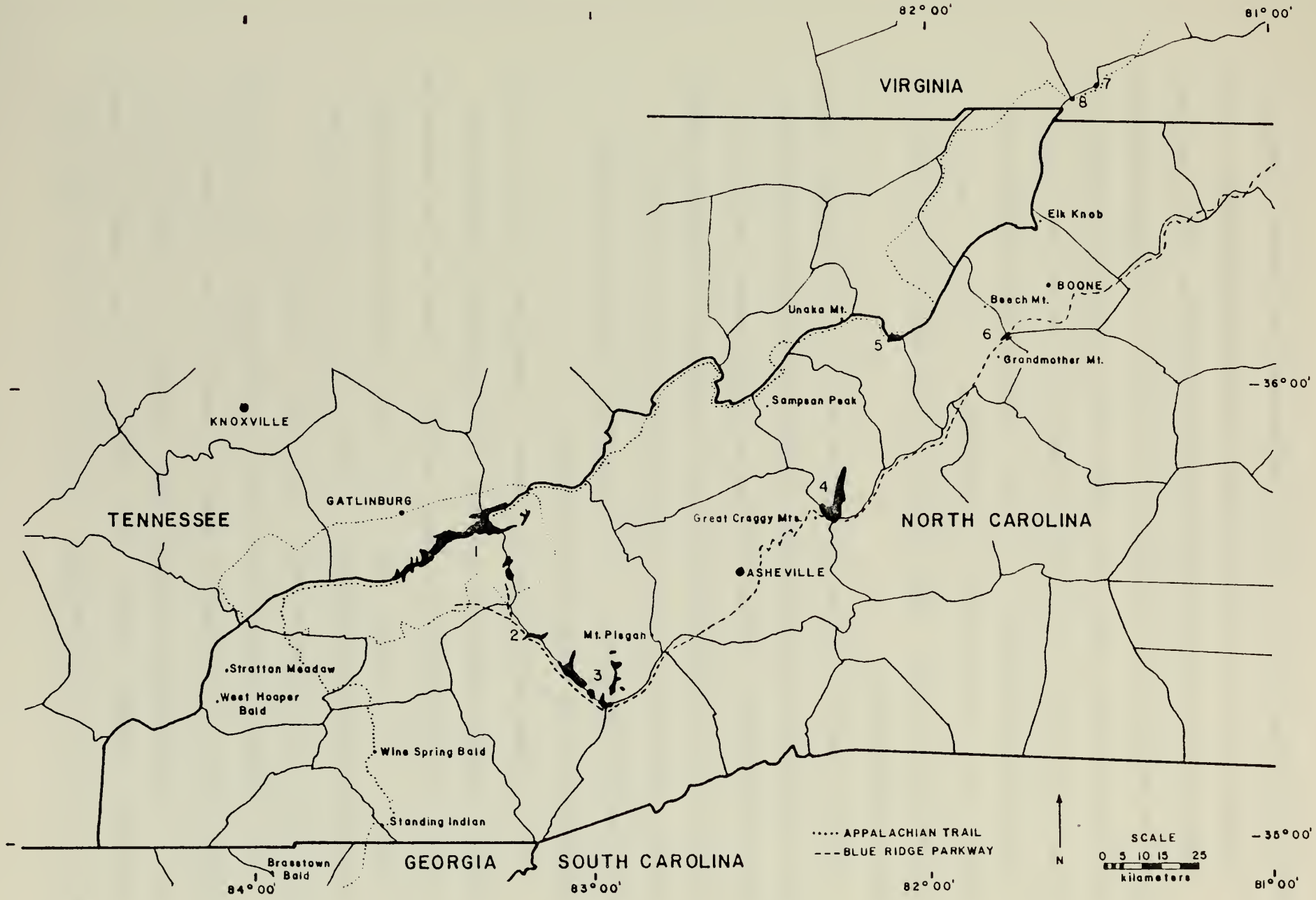
Southern Appalachian Mountain balds were so named because the gaps or ridge tops or peaks of certain mountains lacked either the dense cover of hardwood forests or spruce-fir forests. Instead, these sharply contrasting areas were covered with grasses and herbs, or a variety of heath shrubs, or a mixture of grasses, shrubs, and large, widely scattered trees. The origins of these balds has been the subject of ecosystem research, and numerous theories exist. Some of the balds, which were also known as "fields", were probably cleared or expanded by white settlers, some are reputed to have been cleared by the Cherokee or their ancestral Indians, and others may have been formed by natural catastrophic fires, climatic changes, or a combination of identified and unidentified causes. While the issue of cause has not been settled to the satisfaction of all concerned, one thing is clear, most if not all balds are rapidly succeeding to some type of forest vegetation. At the current rate of plant succession, most of the remaining balds will be under a partial or full forest canopy by the end of the century.

The Southern Appalachian balds are an important cultural and historic resource of this region. Historically, they were used to graze cattle, sheep, and horses. Entire mountain valleys sent their livestock to be tended by herders during the summer months, thereby releiving the farmers of an extra work load, permitting additional land to be converted to crops rather than pasture, and eliminating the need to fence livestock out of the crop lands.

Figure 1. An orientation map to some of the mountain ranges with balds and some of the important balds within the Southern Appalachian Mountains. An outline of Great Smoky Mountains National Park, and the location of the Appalachian Trail and Blue Ridge Parkway are also shown.

Areas Identified by Numbers:

1. Great Smoky Mountains
2. Plott Balsam Mountains
3. Balsam Mountains
4. Black Mountains
5. Roan Mountain
6. Grandfather Mountain
7. Mt. Rogers
8. Whitetop Mountain


82° 00'
81° 00'
VIRGINIA
7
8
Elk Knob
BOONE
Beech Mt.
Unaka Mt.
5
6
Grandmother Mt.
36° 00'
Sampson Peak
KNOXVILLE
GATLINBURG
TENNESSEE
4
Great Craggy Mts.
NORTH CAROLINA
1
ASHEVILLE
2
Mt. Pisgah
3
Stratton Meadow
West Hooper Bald
Wine Spring Bald
Standing Indian
Brasstown Bald
GEORGIA
SOUTH CAROLINA
35° 00'
..... APPALACHIAN TRAIL
---BLUE RIDGE PARKWAY
N
SCALE
0 5 10 15 25
kilometers
84° 00'
83° 00'
82° 00'
81° 00'

Numerous tales have grown up about the herders and their heroics. Some of the local residents can still vividly recall these bygone days.

These balds are also an important scientific resource. The balds provide an excellent area to study plant succession, as well as to study and speculate on their origin. The larger balds can, through management, provide hunting habitat for migrating golden eagles and resident ravens. The balds also provide habitat for several threatened and endangered plant species, as well as habitat for the southern most extension of several plant and animal species. Unusual genetic hybrids and swarms may also be found on certain balds.

Finally, the balds are an important aesthetic and recreational resource. Many flowering herbs and the beautiful purple rhododendrons and multihued flame azaleas abound on the balds during the spring, summer, and fall. To the hiker who has traveled through miles of forests and rhododendron tunnels, the balds provide one of the few opportunities to view the undulating, heavily vegetated landscape. In addition, they offer sites for camping, picnicking, and other recreational activities.

If the current rate of plant succession is permitted to continue, these cultural, historic, scientific, aesthetic, and recreational resources may be lost for future generations to share and enjoy. These are the reasons why scientists, resource managers, and the public are concerned with the future of these balds and their management. If any balds are to be kept open and their integrity maintained as balds, action must be taken soon.

This workshop, through the eight formal presentations, work of the five discussion groups, and interaction among interested parties, addressed the issues of research needs, management needs, and public involvement for the first time in a common location. The following papers and summaries accurately depict the issues of bald management. They provide the first in depth look

at this subject by all of the interested parties. It is hoped that as a result of these efforts and the Proceedings, progress can be made towards determining if balds will be managed, what balds will be managed, and how they will be managed.

NATURAL ORIGIN AND MAINTENANCE OF SOUTHERN APPALACHIAN BALDS: A REVIEW OF HYPOTHESES

Kim Moreau Peterson
Department of Botany, Clemson University, Clemson, SC 29631

INTRODUCTION

High mountains throughout the world are capped with vegetation devoid of trees; even at the equator one can climb above forest on mountains. Many more not-so-high mountains are tree covered. In the Southern Appalachians one can climb above the trees only on certain peaks. Other mountain tops including Mt. Mitchell, the highest in the region, are forested to their summits. The treeless mountain tops, which are known as balds, all exist below the elevational limits of tree growth. Why do these balds exist in a floristically rich forest region? The challenge of this enigma has led to many hypotheses explaining various aspects of the balds phenomenon. Despite the small area involved, the scientific and aesthetic uniqueness of balds has led to continued interest in their causes.

Whether balds are entirely natural or are the result of human disturbance is a controversy which persists, in part, due to a lack of hard data concerning bald origins. Disagreement concerning bald origins is much broader than a simple choice between natural and anthropic causes. A variety of explanations of balds are based upon natural factors such as wind, fire, soil, insects, or climatic changes. Similarly, origin by human disturbance may be attributed to Indians (Wells: 1936, 1937, 1946) or to early white

settlers (Gersmehl 1970). For a review of these hypotheses see Smathers (1981). Also fueling controversy is the assumption implicit in many papers that all balds must have originated in the same way. Data which exists for one bald have often been extrapolated to all balds, even though variations among balds exist. This confusion is compounded by differing concepts of what constitutes a bald.

THE BALDS CONCEPT

The term bald is variously interpreted, having been used more generally in place-names and on maps than is desirable for a scientific study. While authorities generally exclude as balds tree-covered mountains (even though many such mountains have 'bald' associated with their name) this is about the extent of agreement on the question 'when is a bald a bald'? Some authors argue that all balds owe their origin to people; other authors exclude treeless areas of anthropic origin from consideration as balds. It is not my intention to define balds anew, however, it is important for the reader to remember that throughout the literature reviewed in this paper, variations exist in the balds concept which contribute to variation in the explanations of origin and maintenance of balds. Workable systems of nomenclature for balds and bald-like areas are presented by Gersmehl (1970) and by Lindsay and Bratton (1979b).

Despite the varied use of the term bald, two general categories of balds are usually recognized: 1) grassy balds, and 2) heath balds or heath slicks (also called "laurel slicks" by mountaineers, who refer to Rhododendron as laurel and Kalmia as ivy). Grassy balds are, or at least were, characterized by the grass species Danthonia compressa Austin, which along with other

graminoids forms a dense turf. Heath balds are characterized by thickets of ericaceous shrubs; among these are species of Rhododendron (particularly Rhododendron catawbiense Michaux), Kalmia latifolia L., and several species of Vaccinium. Grassy balds are perhaps more commonly referred to in the literature, but many authors do not indicate whether they are referring to one or both types of balds. Some authors consider both grassy balds and heath balds as different facets of a common phenomenon.

ANTIQUITY OF BALDS

The antiquity of balds, or at least some balds, is assumed by most authors. Those who feel that balds are of recent (post-European settlement) origin are quick to point out the lack of solid evidence for earlier existance of balds (Gersmehl 1970). The fact that the earliest explorers and botanists of the region make no mention of the balds seems odd. One must keep in mind the small area of balds in contrast to the regional expance of wilderness at the time of the early explorers and remember that it is not the highest mountains which show bald development but lesser peaks. It is possible that balds could have escaped detection by many early travelers since the virgin forests afforded few vistas.

The vegetation of balds has been of little use in establishing the antiquity of these areas. The similarity of the vegetation established in certain areas known to have been cleared fields to that of grassy balds demonstrates that such vegetation does not require a great deal of time to develop. Determining antiquity from the vegetation is further complicated by disturbance due to grazing and by current invasion of many balds by woody species (Lindsay and Bratton: 1979a, 1979b, 1980).

The depth and nature of soil development observed by Cain (1931) has been used as evidence of the ancient origin of some grass balds. A comparison of the soils of known fields with those balds of suspected antiquity could be useful in resolving the question, but this has apparently never been done. Not necessarily showing deep soil development, some heath balds are thought to represent a stage in primary succession on rocky ridge crests and outcrops (Whittaker 1956). While soils have perhaps recorded more of the history of balds than has the vegetation, much less information is available concerning the nature and extent of soil development from various balds. The question of antiquity remains open for many balds.

THE HYPOTHESES

The earliest literature on balds consists of the casual comments and conjecture of naturalists who were puzzled by the existance of balds. The first written explanation of balds is found in the journal (1799-1814) of John Lyon, who attributed the treeless nature of the Roan Mountain summit to cold or wind or a combination of these factors (Ewan and Ewan 1963). Another early account by Zeigler and Grosscup (1883) also supposed wind to be a probable cause of treelessness on mountain peaks. Harshberger (1903), based upon Edson's (1894) description of ice forms on Roan Mountain, proposed ice storm injury as a possible explanation for treelessness.

Following these early naturalists, several hypotheses concerning the causes of balds were introduced, but few hypotheses were accompanied by new observations or quantitative data. Davis (1929,1930) seriously studied the balds and proposed the importance of several environmental factors. Principal among these factors were aspects of the soil, including shallowness of the

soil, soil acidity, and extremes of soil temperature. As previously noted, variations exists in the depth and nature of soils among balds. Shallowness of soils is potentially an important factor where heath balds are associated with rock outcrops. Little evidence can be found to support the importance of soil acidity. It is generally true that temperature fluctuations are more extreme at the soil surface in forest openings than at the soil surface under forest canopies. While temperatures extremes *per se* might be an important mechanism in the maintenance of balds, observations of frost heaving of tree seedlings (a secondary effect of temperature) may be even more important (Dan Pittillo, personal communication 1980).

In addition to factors of the soil, Davis (1929, 1930) suggested the possible importance of fire. Referring specifically to heath balds, Cain (1930) suggested that destruction of trees by fire, windfall or landslide permitted the establishment of closed heath communities resistant to subsequent reinvasion by trees. Clements (1936) suggested fire may play a role in the establishment and maintenance of heath balds. The recent work of Lindsay and Bratton (1979a) suggests that fire is unimportant in the maintenance or formation of grassy balds. The importance of fire in heath balds needs further investigation.

One other observation of Davis (1929, 1930) derserves mention; he noted that openings in the forest (balds) tended to be near the transition zone between hardwoods and spruce-fir. The importance of this observation will become clear below in the discussion of climatic origin of balds. Many of the observations of Davis are useful, despite the rejection by Fink (1931) of all previously espoused theories and the suggestion that Cherokee legend was an adequate an explanation as had yet been devised.

Several papers suggest the importance of drought stress as a possible factor involved in the maintenance of balds or in some cases even the origin of balds. Camp (1931) was the first to suggest moisture stress as an important factor. He attributed balds to the effects of desicating southwest winds and occasional periods of extreme drought. Peattie (1936) felt that the isolated nature of the peaks upon which balds were found led to excessive evaporation which accounted for their treelessness. Daubenmire (1954) hypothesised that balds may occur in an elevational zone of reduced precipitation. Whittaker (1956) stated the likelyhood that unfavorable moisture balance had excluded trees from grassy lands, citing as evidence the tendency of balds to face south and west.

Brown (1941) noted the potential importance of soil moisture deficiency, but also suggested that overturning of trees by wind could be an important factor. Wells (1936) and later Mark (1958) observed undulations of the soil which they felt had resulted from windthrown trees. Wells (1936) felt that windthrows may have been important in the expansion of balds, but he left the origin of balds in the hands of Indians.

Insects have been invoked in explanations of balds in specific locations. Gates (1941) noted the occurence of gall wasps at two balds which he describes as anomalous; although he felt these insects might be an important factor at these sites, he did not suggest that insects account for the occurence of other balds. Gilbert (1954) also noted insect damage as a factor, but he contended it was not sufficient to explain the origin of balds. Gilbert was the first to explicitly state that the questions of origin of balds and maintenance of balds are distinct.

The difference between questions of origin and maintenance is seen in hypotheses of bald origin based upon climatic changes. Factors responsible for maintaining balds are clearly seperable from past climatic changes. Cain in Yard (1942) was the first to conclude that the balds are relictual, having originated in a xerothermic period through the destruction of dwarf northern hardwood forest. Cain also points out the potential importance of grazing and trampling (presumably to bald maintenance). Whittaker (1956) recognized the importance of post-Wisconsin climatic warming to the distribution of spruce-fir forests in the Great Smoky Mountains, and the hypothesis was expanded by Billings and Mark (1957) to account for the production of balds. The idea is simply that spruce-fir must have retreated up the mountains (and northern hardwoods advanced up the mountains) during a post-Wisconsin warmer-than-present interval (xerothermic in Whittaker 1956, hipsithermal in Billings and Mark 1957). Some mountains were high enough to maintain local refugia of spruce and fir as these forest were pushed higher, but spruce-fir forests were extripated from other lower mountains and hardwoods covered their summits. Following this warm period, recent climatic cooling forced hardwoods to retreat from higher elevations. On mountains where spruce and fir had persisted they were able to follow the hardwoods down the mountain again, but wherever spruce and fir were locally absent balds originated. This explanation has the advantage of accounting for the narrow elevational range in which balds are found, and for the fact that balds tend to occur near the ecotone between northern hardwoods and spruce-fir forests. The slow migration of spruce-fir forest and short dispersal distances of these species also seem consistant with a climatic explanation of bald origin and may help to explain bald maintenance.

DISCUSSION

Perhaps the best way to account for bald origins is to follow the lead of Mark (1958) in recognizing that many factors could have worked together with past climatic changes to produce these forest openings. Several factors may also operate at various times or in certain combinations to maintain balds. While more recent work on bald origins (Gersmehl 1970) concluded that early settlers were responsible for the formation of balds, the possibility of natural origins cannot be rejected. The question of how balds originated remains controversial, but natural origins of some balds seems probable.

The question of how balds are maintained (or are they maintained?) should be easier to address experimentally than the question of bald origins. The conifer plantings of Brown (1953) and of Mark (1958) demonstrate such an experimental approach. While maintenance is probably more easily studied than origin, a complete understanding of the processes involved in maintenance of balds is far from a reality. Consideration of the maintenance of balds is confused by past use of these areas for grazing; which on one hand may have been a factor involved in bald persistance, but on the other hand may represent a disturbance to these systems in terms of nitrogen input or soil erosion which has irreversibly destroyed the conditions necessary for natural maintenance. It appears as if many balds are not currently being maintained. The invasion of some balds by woody species is well documented (Lindsay and Bratton 1980). The current status and dynamics of balds is considered further by Pittillo (1981). Many factors may be involved in bald maintenance, and experimental work is needed to resolve the relative importance of these factors.

In light of the variations which exist in the balds concept and in balds themselves, it is especially important to consider the possibility that not all balds have a common origin or are necessarily maintained by the same processes in every case. Such an approach has been taken by some authors in reference to grassy balds as opposed to heath balds, but it might also be applied to balds with similar vegetation. The fact that several treeless areas in the Southern Appalachians are more or less similar to one another in no way guarantees that they are of common origin. Imagine the formation of a bald through a combination of insects and fire extripating the remaining climatically weakened spruce and fir on one mountain peak, while a second bald is formed through similar action of drought and wind on another peak, and thousands of years later a third bald is formed when early settlers clear a dwarf northern hardwood forest to form a pasture. Similar vegetation would be expected to occupy all three sites, and many similarities in climate and other physical factors might also occur; but to assume a common origin based on this similarity would be misleading. While it is likely that many balds were caused by similar mechanisms, data and observations associated with one bald should not be automatically applied to all balds. The role of natural factors in the origin and maintenance of balds requires further research in which each bald should first be considered independently and generalizations should follow only after the same results are obtained from studies of several balds. Through such an approach we may solve the controversy of whether balds are natural or man caused in that the answer is most likely both.

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THE ANTHROPIC FACTOR IN SOUTHERN APPALCHIAN BALD FORMATION

Garrett A. Smathers
National Park Service, Western Carolina University
Cullowhee, North Carolina 28723

INTRODUCTION

The most puzzling features of the high Southern Appalachian Mountains are the treeless areas that cover some summits. These areas are referred to locally as balds. So far, scientific efforts to explain their origin have not found wide acceptance. Those studies which infer that balds are the result of physical factors such as catastrophic fires, climatic change, soil conditions, or extreme exposure to topographic and aspect position have found wider acceptance among plant ecologists. One study infers that the balds were created by ancient Indians long before the appearance of European man. Scientists have found that some balds were present before white man settled the area. The latter are referred to as natural balds. Investigators have also found that many balds were created by settlers clearing the high summit and gap forests. It is the purpose of this paper to evaluate the human or anthropic factor in bald formation based upon past studies and observations. The area of study covers the contiguous seventeen western counties of North Carolina. Major balds are located in the counties of Buncombe, Haywood, Jackson, Macon, Transylvania, and on the county borders of Mitchell and Swain with the state of Tennessee. The chronology of white man's appearance and settlement of this area provides further insight into evaluating the anthropic factor.

EARLY VISITORS

The first white man to visit the area was the Spanish explorer, Hernando De Soto, in search of gold in the "new world." It is believed that De Soto passed over the Blue Ridge at Hickory Nut Gap and across the headwaters of the French Broad River and probably passed near Whiteside Mountain about 1560. (Sondley 1930a). The Spanish explorers made no mention of the vegetation features of the area. Sondley, in his History of Buncombe County, stated: "It appears that prior to 1701 a passage through a gap of the western North Carolina mountains had been made by an English party." He gives no further information as to members of the party or what they found. The next known visit to the area was in 1730, when an expedition of ten white men and two Indians left eastern North Carolina to explore the western area (Sondley 1930a). The leader, Dr. John Brickell, reported that within fifteen days they reached the foot of the mountains, where they met Indians that at first appeared to be unfriendly, but later the Indians accompanied his party into the mountains to help protect against other Indians that might be there. After passing over the first ridge of mountains (probably Blue Ridge), Brickell reported that they saw beautiful valleys covered with woods, pastures, and savannahs (open grassland with trees and shrubs). Also they saw forests oflarge trees "as far as the eyes permit." The reference to "savannahs" and "pastures" approaches the nearest description to balds. In 1775, the naturalist William Bartram visited the region but he did not mention the balds. However, he did mention meadows near lower mountains where a trader by the name of Galahan pastured his horses. He also noted a "grassy plain" near Burning Town Gap (4300 ft.).

The next known entry of white man into the area was in 1776, when General Griffith Rutherford, with an army of 2400 soldiers, crossed the Blue Ridge and

Balsam Mountains and descended upon the Cherokee Indian towns of the interior mountains. This attack was meant to subdue and subjugate the Cherokee as retaliation for their having invaded and depredated North Carolina settlements in the mountain margins. James Hall, a minister in the expedition, is credited with naming Mount Pisgah, a heath bald summit that projects high above the French Broad River basin (Lord 1976).

The French botanist Andre Michaux visited the area in 1789 trying to follow Bartram's trail. Later in 1794, he climbed to the top of Grandfather Mountain, but on neither visit did he make mention of balds.

The early explorations and expeditions from eastern settlements provided information on the natural resources of the mountainous area. Records and stories brought back encouraged other to move westward and settle in the mountains. In 1783, the State opened the area east of the Big Pigeon and its headwaters to the southern border of the state (Sondley 1930a). Hunters began visiting the area and deciding to settle there. Many meadows were present, and it was good land for turning cattle and horses loose to range.

In 1784, Samuel Davidson crossed the Blue Ridge and settled on a tributary of the Swannanoa River. He was killed by Indians just a few days after building his cabin. However, only a few months later his relatives and friends established a colony at the mouth of Bee Tree Creek, a tributary of the Swannanoa, and only a few miles from Davidson's grave (Sondley 1930a). This settlement is considered the first permanent white settlement southwest of the Blue Ridge. The Bee Tree settlement was the beginning of a vast flow of pioneers into the rich mountain valleys and forests. Chronological settlement of the area is best indicated by the establishment of counties beginning east of the Blue Ridge and progressing westward to the Great Smokies: Buncombe, 1791; Haywood, 1808, Macon, 1828; Cherokee, 1839, and Clay, 1861.

Although there are no recorded accounts of the presence of balds during the early settlement periods, several references were made to high pasture meadows of similar physiogonomy. Sondley (1930a) stated that "when the early settlers arrived...(1784)...most of the river valleys and many of the mountains were prairies (grasslands) and destitute entirely of trees and shrubs."

Elisha Mitchell gave the first descriptive account of the highland balds. While measuring mountain peaks, he described the Roan Mountain bald as follows (Mitchell 1835): "With the exception of a body of rocks looking like the ruins of an old castle, near the southwestern extremity, the top of the Roan may be described as a vast meadow, without a tree to obstruct the prospect; where a person may gallop his horse for a mile or two."

Later in 1838, while on a geological exploration of the mountains, Mitchell described cattle ranging in the mountains of the Jefferson area. He commented that even though the mountain tops were covered with large chestnut and oak trees, they still afforded a good deal of pasturage (Battle 1905). He recommended the areas for raising livestock.

T.L. Clingman in 1855, in a letter to Professor Joseph Henry describing the physiography of the Black Mountain from a high vantage point in the Blacks, gave the first description of the Craggy Mountain balds. Clingman stated: "As the chain of the Blacks sweeps around westwardly it is soon parted into immense branches, which run off in opposite courses . . while to the south there leads off the long ridge of Craggy, with its myraids of gorgeous flowers, its naked slopes and fantastic peaks, overwhich dominates its great dome, challenging in it altitude ambitions comparison with the Black itself" (Sondley 1930b). From Clingman's observation point, he was viewing the spectacular purple rhododendron and open grassland of the Craggy Gardens area. Clingman's observations

were made before there was any significant settlement made in the foothills of the Craggies.

It is puzzling why botanists who made early visits to the area never mentioned the balds. Wells (1937) in his study of balds, pointed out that Asa Gray visited the Roan Mountain bald in 1841, but that he did not mention the large grassland feature. Wells believed that when Gray saw the extensive livestock grazing, he reasoned that the area had been cleared by the mountaineers. Wells stated that other early taxonomists such as Lamson-Scribner, Curtis, Buckley, and Chickering also had visited the Roan Mountain summit, but none discussed the origin or maintenance of the grassland. The above account of visits, exploration, and settlement of western North Carolina indicates that some balds were present prior to white man.

EXPLOITATION OF THE MOUNTAIN ENVIRONMENT

The first settlers were exploiting the natural balds for livestock grazing before such recommendations were made by Mitchell. Since these early people had to live close to the land to survive, they became quite conscious of environmental features and conditions that helped provide food, shelter, and clothing. The majority of these early immigrants were of Scotch-Irish descent; therefore, they found the cool-humid mountain environment quite similar to that of their native land. Undoubtedly, the open forests, heath-grasslands, and lush grassy balds of the high summits, ridges, and gaps offered agriculture uses similar to their native highlands. At lower elevations, the forest wilderness covering coves and valley terraces became an obstacle to agriculture; even though it provided game, wood for shelter, farm buildings, fuel, and other necessities. Removal of upland and lowland forests by felling

and burning the trees was a large undertaking, especially for the small isolated family units. Lacking the manpower, equipment, and time, these mountaineers resorted to a type of forest removal, that by the turn of the 20th Century, was considered to have one of the most devastating impacts upon the Southern Appalachian Forests (Roosevelt 1902).

Large tracts of forest land were removed by the simple method of girdling (locally called "ringing"). Girdling consisted of cutting a ring around the tree, deep enough into the trunk to destroy the food transport and cambium tissue. This method killed the tree without felling it. With the leaf-canopy destroyed and light able to reach the ground, these areas under minimal cultivation became suitable croplands, or places where grasses and sedges could provide forage for livestock. Forest of most summits and gaps with deep soils were ideal sites for croplands and pastures. Today, some of these localities, many still in shrub-grassland, have names which connote their earlier use. For example, Potato Field Gap at 4600 feet elevation in the Craggy Mountain was named for the large crops of Irish potatoes grown there. Henders planted gardens on the high gaps and summits and tended them through the summer (Lord 1976).

The term bald was used by mountaineers for various physiographic features and their associated vegetation cover. Arnold Guyot in his survey of the western North Carolina mountains noted that the term "bald" could apply to forested peaks as well as treeless ones (Avery and Broadman 1935). In addition, Mark (1958) in his study of the balds found the terms used for summit areas cleared for fire towers, recently deforested grasslands and fields, as well as the true grassy balds in existence before the first settlers. The mountaineers considered areas of continuous grass-sedge coverage, as well as those with

shrubs scattered throughout the grassland, to be balds. However, where shrubs were compact and formed the dominant cover, these areas were called "slicks" (Wells 1936b).

NATURAL AND MAN CREATED BALDS

The fact that European man was an important factor in the formation of some balds has been well-established by earlier studies, observations, and historical records (Wells 1937, Mark 1958, Gilbert 1954, Brown 1941, Gersmehl 1970). A recent study by Lindsay (1976), of the history of grassy balds in the Great Smoky Mountains National Park, confirmed that man created balds as well as extended natural ones.

Gilbert (1954) was the first to recognize that bald origin and maintenance were separate factors to be considered in bald studies. After studying balds in the Great Smoky Mountains National Park, he concluded that he could not determine from his vegetation analyses whether or not a bald had been cleared by man. A few investigators believed that the balds were initiated by fire, either by lightening strikes or man firings. Both Core (1929) and Clements (1936) believed that heath balds ("slicks") were initiated and maintained by fire. Later Gersmehl (1970) also believed that fire initiated heath balds.

The question began to arise: Why did the forest not return to the European man-made balds as well as the natural ones? Also, some of the natural balds had increased in size after settlement of the area. These observations caused researchers to turn more attention to bald maintenance and extension.

Core (1929) was the first to recognize that grassy balds were being maintained and extended by domestic livestock trampling. Later Camp (1931) recognized that grazing by livestock and deer not only maintained but extended grassy balds. He also noted that man extended the balds by firings (see Yard

1942). Gilbert (1954) and Griggs (see Yard 1942) presumed that continual browsing and trampling maintained the grassy balds. King and Stupka (1950) after studying natural balds of the Great Smokies contended that they were maintained by prevailing winds and grazing livestock. Gersmehl (1970) supported the early observations that the grassy balds were maintained by grazing and firing.

On the mater of forest returning to the man-distrubed sites, investigators have not been in agreement as to the type of seral developments and rate of recovery. Brown (1941) studied bald sites in Virginia at 3000-4000 feet elevation. These were known sites where European man had cleared the forest. He found that trees had not been able to invade the grasslands, even after the disturbing factors had been removed for seventy-five years. He believed that the grassland was able to dominate the cover because of its intense root competition with woody seedlings. However, Wells (1937) was the first to state that the balds dominant cover of mountain oat grass (Danthonia compressa) was able to hold back the invasion of woody plants. Wells believed that when the pre-European man-made balds were abandoned that they would not return to forest. He contended that the native oat grass was extremely competitive with herbaceous as well as woody plants. And regardless of the severity of destruction of the grassland, at the cessation of grazing the mountain oat grass would return and dominate the cover. Jenkins (1951) concluded from his investigation that the native mountain oat grass became established only in areas of long-term disturbance.

Other investigators did not agree with Brown and Wells on the dominancy of mountain oat grass. Camp (see Yard 1942) maintained that once grazing was removed, the balds would return to a shrub meadow. Griggs, (see Yard 1942) argues that once logging and grazing were removed, the balds would disappear.

CRAGGY GARDENS-EXPLOITATION OF A NATURAL BALD

Area Geography

A recent study initiated in Craggy Gardens, a heath-grassland on high summits of the Great Craggy Mountain, is designed to evaluate the impact of European man upon a natural bald. The Great Craggy Mountain is an extension of the Black Mountain range into the French Broad River basin. A sharp discontinuity of vegetation patterns occurs where the Black and Craggy connect. Here the spruce-fir forest of the Black meets the hardwood forest of the Craggy. This sharp contrast mystifies plant ecologists because the high Craggy have a potential for spruce-fir forest, yet the latter has only made minimal invasion beyond the juncture. The contrasting pattern was present when the first settlers arrived.

At present the highest elevation and gaps of the Craggy are covered with a variety of vegetation varying from open grassland, heath-grassland, to heath "slicks." These areas are under invasion of the contiguous gnarled hardwood forest consisting of oak, beech, birch, buckeye, and mountain ash. Recent study of historic photos and accounts of oldest living inhabitants and early visitors indicate that the zones being invaded were once forested areas that surrounded a much smaller open, natural grassland extending along the highest summits. The presence of these grass-heathlands before their exploitation by early settlers is confirmed by Clingman's previous description in 1855 of the bareness of areas. In addition, Davis (1930), in his study of the Black Mountains and talks with the oldest inhabitants of the area, was told that the Craggy balds were present before the first settlers.

CHRONOLOGY OF EUROPEAN MAN'S IMPACT ON THE AREA

From the earlier accounts of settlement west of the Blue Ridge, it is likely that the foothills of the Craggy Mountains were sparsely settled during the early 1800's. But by 1850 it is estimated that settlements became more numerous and the high Craggy Mountains became more attractive for livestock pastures. From 1850-1900 settlement increased and the western North Carolina area was looked upon as an agriculture based economy with demand for its products and resources from the outside. A complex network of trails and wagon roads connected the area with the regional markets. This system, called the Buncombe Turnpike, was the route used by drovers who herded thousands of cattle, sheep, hogs, chickens, and turkeys to be sold on the southern plantations (Eller 1979). It was reported that large numbers of cattle, swine, and sheep were raised in the Appalachians. Livestock was turned loose in the woodlands or driven to the high grassy balds (Eller 1979). Sheep raising on the rocky hillsides was a common practice. During the Civil War, 1861-1865, a large portion of the wool used in the Confederate uniforms came from western North Carolina (Dan Brown, 1980, personal communication). Thus, the high elevation open forests and grasslands of the Craggy Mountains became very attractive for the livestock industry during that period. In his study of preindustrial Appalachia, Eller (1979) noted that "By the late nineteenth century, large portions of the mountain hillsides had been cleared (usually by burning or girdling of trees) for the raising of cattle, sheep, mules, and fowl."

Recent discovery and historic photographs (W.R. Barnhill collection, Pack Memorial Library, Asheville, North Carolina), which show scenic coverage and use of the Craggy grassland by sheep herders at the turn of the century, provide factual evidence of man's exploitation of the area. From these photographs

it can be inferred that the small open strips of natural grassland were subjected to livestock grazing in the mid-1800's. Continual removal of the forest margin, by girdling trees and possibly firing, extended the grass and shrubland. The impact also extended into the marginal forest, where today large and widely spaced relict trees reveal an earlier parkland appearance. Here the heavy browsing and grazing suppressed tree-seedling regeneration. The large open grassland with purple rhododendron (Rhododendron catawbiense) scattered throughout became known as Craggy Gardens.

At the close of the nineteenth and into the twentieth centuries, the Craggy Gardens became known for its beautiful pastoral scenery and purple rhododendron displays. Postcards were sold in the early 1900's that showed great flocks of sheep grazing upon the slopes and summits of Craggy. The large open grass and heath balds became attractive for outdoor recreation. By the early nineteen hundreds over six hundred acres of the Craggy Gardens open-heath and grassland were used for camping with access being by hiking or horseback trails.

The use of the Craggy Gardens for grazing began to decline in 1920, when the city of Asheville purchased and fenced the summit lines of the southern slopes for its municipal watershed (Kring 1965). Cattle grazing continued on the southwest summit line and slopes, though not as heavy as in former years. The area became more oriented for public recreation use in 1932 when the U.S. Forest Service acquired most of it. In 1950 all of Craggy Gardens was closed to grazing when the area was taken over by the National Park Service for the Blue Ridge Parkway.

INVASION OF HARDWOOD FOREST

With the removal of grazing pressure, the extended heath and grassland was quickly invaded by the marginal forest. Tree seedlings began to get established beneath the open canopy of the relict parkland forest of old trees. Preliminary evaluation of the invading vegetation by aerial photos, historic photos, and field transect data revealed that since the removal of grazing the forest has been encroaching on the grassland at a rapid rate.

Since 1950, the Park Service has not encouraged, and in some localities has not permitted, use of the high summit trails of former years. As a result, some of the broad pasture trails of the 1900's that crossed the summits of Craggy Knob, Craggy Dome, and Bullhead Mountain have been replaced by heath slicks and forest. Comparison of 1915 photos with recent ones reveal an explosive invasion of the forest in these areas. Some of the invaded localities are believed to be parts of the natural grassy ridge and summits that existed before the appearance of white man. These questions arise: Why are these natural sites now being invaded when they were resistant before the white man's exploitation? Is it possible that the severe trampling, animal compost, and erosion of these sites have destroyed the capability of the turf to resist woody plant invasion?

INDIAN ROLE IN CREATING BALDS

Plant ecologist, B.W. Wells, after painstakingly studying the vegetation component and geographic positions of the natural balds, developed a hypothesis that they had been created by earlier ancestors to the present Cherokee Indians. The Wells hypothesis will be discussed in more detail below.

Mythology

The Cherokee had no difficulty in explaining the origin of the balds. The legends about these features had long been a part of their mythological heritage, which has been passed on from one generation to another. James Mooney (1900) described a version of the U'la'gu' myth from Lannon, that explains the origin of the natural balds.

> "The Cherokees relate that there once existed among these mountains (about Nantahala and Franklin) a very large bird, resembled in appearance the green-winged hornet (U'la'gu') and this creature was in the habit of carrying off the younger children of the nation who happened to wander into the woods. Very many children had mysteriously disappeared in this manner, and the entire people declared a warfare against the monster. A variety of means was employed for his destruction, but without success. In process of time it was determined that the wise men (or medicine-men) of the nation should try their skill in the business. They met in council and agreed that each one should station himself on the summit of a mountain and that, when the creature was discovered, the man who made the discovery should utter a loud halloo, which should be taken up by his neighbor on the next mountain, and so continue to the end of the line, that all the men might have a shot at the strange bird. This experiment was tried and resulted in finding out the hiding place of the monster which was a deep cavern on the eastern side of the Blue Ridge and at the fountain-head of the river too-ge-lah (Tugaloo River, South Carolina). On arriving at this place, they found the entrance to the cavern entirely inaccessible by mortal feet, and they therefore prayed to the Great Spirit that he would bring out the bird from his den, and place him within reach of their arms. Their petition was granted, for a terrible thunder-storm immediately arose, and a stroke of lightening tore away one-half of a large mountain, and the Indians were successful in slaying their enemy. The Great Spirit was pleased with the courage manifested by the Cherokees during this dangerous fight and, with a view of rewarding the same, he willed it that all the highest mountains in their land should thereafter be destitute of trees, so that they might always have an opportunity of watching the movement of their enemies."

Mooney gives several other Cherokee legends that are associated with the bald phenomenon. Among these are:

1. The mythical giant Tsul'kalu or Jutaculla developed and lived on the balds of the Balsam Mountains at the headwaters of the

Tuckaseegee River.

2. A giant lizard that glistened lived on Joanna Bald, where it could be seen sunning itself.
3. Near the town of Robbinsville two small balds were created when a giant with a blazing head alighted there.

Ancient Cherokee

The ancient and present Cherokee Indian seemed to have had different life-styles as suggested by some investigators (Wells 1936b). The Indians first seen by white man were primarily valley dwellers, being mostly farmers and gatherers. However, there is evidence that the ancient Cherokee lives in valleys but moved to the high elevations for summer camp.

Because of this contrast in Cherokee life-styles over the historic past, one of the most intriguing hypotheses of the grassy bald origin has been presented by B.W. Wells. After observing the physical conditions, geographic locations, and analyzing the vegetation cover and components of twenty-three grassy balds in the Southern Appalachians (Wells 1932, 1936a, 1936b, 1937, 1938, 1946, 1956), he concluded that the balds were created and used by the Indians many centuries before contact was made with white man. He believed these early Indians used the balds extensively in the summer periods, a custom which was given up by the later Cherokee. These early Indians preferred the ridge trails for travel and hunting. It is believed that they gathered in bands on the balds at night and used trees from the bald perimeter for firewood. Wells reasoned that the continual, intensive occupation of the locality would bring about a herbaceous succession after abandonment.

Wells looked upon the balds as Indian camp grounds that were connected by a ridge-summit trail system. Actually, the grassy bald was considered to

be an expanded node on the trail system. Thus, the present narrow grassy paths along ridges such as Tennessee Ridge and Shining Rock were part of a trail system connecting Tennessee Bald and other balds of this locality.

Of the twenty-three balds studied, Wells found only one to have been created by white man - Crabtree Bald in Haywood County. He found that many of the natural balds had been expanded from their original small opening into a larger grassland by livestock grazing. For example, he stated the Roan Mountain Bald now covering approximately 100 acres was expanded to this size by the "early white mountaineers who destroyed large areas of forest for grazing purposes."

Wells gave three main reasons why the ancient Cherokees used the bald sites.

1. The areas made excellent campsites. Most were located on gentle, warm south-facing slopes, gaps, or summit areas. All had a spring nearby for water. These conditions made the sites suitable for summer camps. In addition, the high-ridge trail to the campsite provided opportunity to observe game and enemies.
2. Some of the small balds located on slopes and ridges were probably used as game lures. Here turkey, deer, and other game animals could be lured into the opening and easily shot. The game-lure balds were not adapted for camping.
3. Some small balds on the high peaks were probably used as lookout stations. An example would be Block House Mountain in Swain County.

Wells observed physical features of the balds to develop his hypothesis. He considered the shape and area of balds to exclude most natural causing factors. He stressed opposition to Whittaker's (1956) theory that grassy balds were the result of climatic exposure. He argued that if this were the case

then why there should now be a rarity of grassy openings along miles of exposed ridges (Wells 1956). He argued that the sharp boundary between grassland and forest was the result of continual tree removal along the periphery line. Bald springs, level land, and deeply eroded campfire spots further suggested that balds were the result of human occupation.

In addition to physical feature observation, Wells analyzed the vegetation cover to further develop his hypothesis. He contended that the balds and trail systems were once deeply eroded down to the subsoil. Upon abandonment these sites were invaded and colonized by a weed-like pioneer stage dominated by Rumex acetosella. This community eventually gave way to a graminoid community dominated by mountain oat grass (Danthonia compressa). Wells contended that the mountain oat grass turf was extremely competitive, to the extent that it prevented woody seedlings from getting established. In one locality he believed the grassland had competitively replaced a narrow zone of shrubs that was transitional to the surrounding forest. He found the species composition of the balds and trails were quite similar, and as a result, he contended that this supported his thesis that the balds and ridge trails were of common origin, i.e. by human trampling. Later, after review of similar "man created vegetations" in forests of other parts of the world, Wells suggested that the balds be recognized under the term, "archaeological disclimaxes."

Finally, Wells argued that the U'la'gu' myth proved the antiquity of the balds, that they had been in existence for many years, and that they had been able to retain their long-term stability without the help of the later Cherokee. However, Gersmehl (1970) believed that this Cherokee myth was of recent origin, probably developed to explain the bald features during the time of white man's influence. Gersmehl provides no concrete evidence to support his contention.

DISCUSSION AND CONCLUSIONS

The anthropic factor is significant in bald origin and maintenance. On the matter of bald origin predating European man, it is not likely that the Wells hypothesis will find wide acceptance until well-disciplined archaeological research is undertaken. The Wells hypothesis is tenable and it deserves to be tested. It is surprising that it has not been vigorously tested before now since Gilbert (1943) reported that projectiles had been found on one bald.

The role of the early settlers in creating balds or extending natural balds has been well documented through recent research by Lindsay (1976,1977). Lindsay and Bratton (1979,1980), Bratton, et al. (1979), Barden (1978), and Smathers (1979). All of these studies show that when the anthropic factor is removed, the bald quickly, in practically all instances, is invaded by the contiguous forest. The question arises: Will this invasion result in a dense forest or will it be one consisting of openings that reflect a site-specific intense microenvironment condition? This has yet to be observed. So important is the anthropic factor that resources managers of the National Parks and the National Forests will have to duplicate it periodically through cutting, grazing, firing, etc. if the historic balds are to be maintained.

Review of the literature on bald origin reveals that most studies are based on the inductive method of research. A simplistic procedure has been used which consists of drawing appropriate inferences upon observed facts. Only a few of the researchers have gone further to test their working hypotheses. Even in those studies when the deductive method of testing has been applied, and where there has been agreement between the deduced consequences and the observed facts, there still remains doubt of the validity of the

hypothesis. For example Barden (1978) believed that results of his research on prescribed burns of shrubs in grassy balds supported Gersmehl's (1970) fire-grazing hypothesis. While this may be true, Barden's work is only one of many such tests needed to validate Gersmehl's conclusions.

The origin of natural balds is not a problem that can be solved by a simple direct approach. It is a complex problem that will require analytical evaluations of observations and inferences as well as assumptions drawn from them. This type of rigorous testing of hypotheses seems to be lacking even in some advanced studies. However, the literature reveals a variety of proposed hypotheses, and herein may lie the eventual definitive answer to the origin of natural balds. More hypotheses and a critical analysis of each are needed.

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STATUS AND DYNAMICS OF BALDS IN THE SOUTHERN APPALACHIAN MOUNTAINS

J. Dan Pittillo

Department of Biology, Western Carolina University, Cullowhee, NC 28723

All the recent evidence on the status and dynamics of grass balds in the Southern Appalachians suggests a decrease in their extent (Gersmehl 1970; Lindsay 1976, 1977, 1978; Barden 1978; Lindsay and Bratton 1979a, 1979b, 1980). The purpose of this paper is to review some of the current ideas dealing with the status and dynamics of the so-called "balds" of the Southern Appalachians in preparation for a unified effort by public agencies to manage the bald areas in public ownership. Included here are communities dominated by grasses, sedges, and herbs or their combination, and communities predominated by heath species, especially Rhododendron catawbiense, the purple rhododendron.

STATUS

In the written records of white man's exploration of the Southern Appalachians there is no particular emphasis on the balds. As Smathers (1981) noted, one of the first mentions of grasslands in the Southern Appalachians resulted from William Bartram's exploration of the area in 1775. He often mentioned "grassy plains", "verdent meadows", "expansive green lawns", etc., but mainly noted these in association with valleys, especially in the Little Tennessee and Nantahala River valleys (Van Doren 1928, p. 268-302). Bartram passed near Wayah Bald in Burningtown Gap of the Nantahalas and noted a descent through a "grassy plain" along the trading path. Wells (1937) suggested that perhaps earlier botanists and naturalists assumed the grass balds were cleared by early pioneers and dismissed high elevation meadows as recently cleared and unnatural openings, rather than features predating European settlement. So it was in the 1930's that we begin to have studies

and reports on the location and extent of grass or heath balds with papers by Cain (1930), Camp (1931), Fink (1931), Wells (1936a, 1936b, 1937), Brown (1941), and Gates (1941).

Wells (1938) described 24 sites while Mark (1959) later evaluated 34 sites he identified as natural grass balds for a total listing of 43 known locations (18 other sites were considered fields or clearings for pasturage or fire lookout towers). These are tabulated in Table 1.

Perhaps the most comprehensive survey of grass balds was undertaken by Phil Gersmehl (1970). Using maps, published data, site names, etc., he evaluated about 240 sites between southwest Virginia and northern Georgia. He was able to visit many of these during his three year study. He classified them into six categories: true balds, historical balds, forested balds, apparent balds, nominal balds, and artificial balds. The definitions he used are as follows (Gersmehl 1970, p. 7-8):

1. True balds are presently grassy areas and have at least two references to the natural treelessness.
2. Historical balds are those indicated in references as natural treeless areas but which are not now grassy areas.

2a. Forested balds are essentially historical balds but are now forested (Gersmehl listed this category in his appendix B but did not include it in his classification system in the main text).

3. Apparent balds have characteristics of balds but have no historical references denoting their natural treelessness.
4. Nominal balds were mountains with the name "bald" but have neither historical records nor physical characteristics of balds.
5. Artificial balds or fields are treeless mountains with historical records or other evidence of their deliberate clearing by humans.

In summary, Gersmehl classified the following numbers of sites under each category:

True balds	34 (he visited 24 of these)
Historical balds	56 (17 of these he called forested)
Apparent balds	29
Nominal balds	71

Table 1

Grass Balds, Fields, and Fire Tower "Balds" Listed by Wells (W) in 1937 and Mark (M) in 1958, arranged by latitude.

	Name	Lat. deg.	(N) min.	Long. deg.	(W) min.
	BALDS				
1.	Whitetop Mountain Bald (M)	36	38	81	37
2.	Big Yellow Bald (M; W as Roan Mt.)	36	07	82	01
3.	Jane Bald (M; W as Roan Mt.)	36	06	82	05
4.	Round Bald (M; W as Roan Mt.)	36	06	82	06
5.	Roan Mountain Bald (M and W)	36	06	82	07
6.	Big Bald (M)	35	59	82	30
7.	Craggy Pinnacle Bald (M)	35	42	82	22
8.	Mount Sterling Bald (M and W)	35	42	83	07
9.	Craggy Knob Bald (M)	35	41	82	23
10.	Crabtree Bald (W)	35	39	82	55
11.	High Spring Bald (M and W)	35	34	83	33
12.	Little Bald (M)	35	34	83	45
13.	Rocky Top Bald (M)	35	34	83	43
14.	Silers Bald (M and W)	35	34	83	34
15.	Thunderhead Bald (M and W)	35	34	83	43
16.	Big Chestnut Bald (W)	35	34	83	38
17.	High Spring Bald (W)	35	34	83	33
18.	Block House Bald (W)	35	33	83	43
19.	Andrews Bald (M and W)	35	32	83	30
20.	Gregory Bald (M and W)	35	31	83	52
21.	Parson Bald (M)	35	31	83	53
22.	Soco Bald (M and W)	35	31	81	12
23.	Bunches Bald (W)	35	31	83	11
24.	Cold Mountain Bald (M and W)	35	25	82	52
25.	Little Pisgah Bald (W)	35	29	82	47
26.	Grassy Bald (M)	35	25	83	03
27.	Big Pisgah Bald (M and W)	35	24	82	46
28.	Shining Rock Gap Bald (M and W)	35	23	82	50
29.	Stratton Bald (M)	35	22	84	00
30.	East Rough Butt Bald (M and W)	35	19	82	57
31.	Indian Graveyard Bald (M and W)	35	19	85	19
32.	Trail Bald (W)[1]	-	-	-	-
33.	West Rough Butt Bald (M and W)	35	19	82	58
34.	Wet Camp Gap Bald (M)	35	19	82	58
35.	Charlie Bald (M)	35	19	82	59
36.	Gage Bald (M)	35	18	82	58
37.	Gage Gap Bald (M)	35	18	82	59
38.	Hooper Bald (M)	35	18	84	00
39.	Rich Mountain Gap Bald (M)	35	18	83	00
40.	Tennessee Bald (M and W)	35	18	82	55
41.	Wolf Bald (M)	35	18	82	56
42.	Old Camp Bald (W)[1]	-	-	-	-
43.	Little Wayah Bald (W)[1]	-	-	-	-

Table 1 Continued

	Name	Lat. deg.	(N) min.	Long. deg.	(W) min.
	FIELDS				
1.	Mt. Rogers Field (M)	36	39	81	39
2.	Hump Mountain Field (M)	36	09	82	01
3.	Yellow Mountain Field (M)	36	08	82	02
4.	Max Patch Mountain Field (M)	35	48	82	02
5.	Middle Ridge "Bald" (M)	35	48	82	15
6.	Little Mountain "Bald" (M)	35	46	82	15
7.	Little Sandymush "Bald" (M)	35	41	82	52
8.	Sandymush "Bald" (M)	35	41	82	53
9.	Crabtree "Bald" (M)	35	39	82	55
10.	Ledge "Bald" (M)	35	34	83	44
11.	Russell Field (M)	35	34	83	46
12.	Spence Field (M and W)	35	34	83	44
	FIRE TOWER CLEARINGS				
1.	Brasstown "Bald" (M)	35	52	83	48
2.	Cowee "Bald" (M)	35	20	83	20
3.	Rabun "Bald" (M)	34	58	83	18
4.	Teyahlee (= Johanna) "Bald" (M)	35	15	83	48
5.	Wahah "Bald" (M)	35	11	83	33
6.	Wesser "Bald" (M)	35	17	83	35

[1]The exact location for these three areas has not been determined

Artificial balds or fields	49
Unclassified	1
Total listed	240

Therefore, based on Gersmehl's criteria, if we combine his true and apparent balds categories we find 63 sites in the Southern Appalachians which may be called natural balds in existence in 1970. Areas not reclaimed by woody vegetation that were once balds numbered 56, while an additional 71 areas are "bald" in name only. The remaining 50 were artificial or unclassified.

How accurate a representation of the current grass bald situation in the Southern Appalachians is Gersmehl's study? Can improvements in technique be made? How much information is available for each site he evaluated? Let us consider each of these questions in turn.

Gersmahl gathered his information from libraries, personal interviews, maps, and on-site visits over the three year period of his study. He treated most of his material logically, judging each piece of evidence, and in this regard he is consistent and accurate. The topographic maps he had available were dated 1967 or earlier, with most having dates in the 1940's or 1950's and one back to 1911. He did not use many aerial photos, but recent photos could improve such evaluations, especially those for which on-site visits could not be made. For example, field experience indicates Naked Ground and Jenkins Meadow in Joyce Kilmer Memorial Forest, which Gersmehl classified as apparent balds, are now fully covered by trees (birches over 6 m tall are found at Naked Ground and fire cherry, birches, and blackberries cover Jenkins Meadow). Using topographic maps for indication of non-forested areas is dependent upon the photo interpreter's judgment and is subject to error without extensive field checking.

Improvement in evaluations is possible for many sites listed by Gersmehl (1970). This could be accomplished by use of up-to-date aerial

photos with confirmation by field evaluations.

Gersmehl's (1970) data only located the sites and gave pertinent historical record. Additional information will be needed in a comprehensive management effort. Included in this information is the size of the bald areas, extent and types of adjacent communities, estimates of invasion rates, current use, and ownership.

DYNAMICS

Many botanists have directed their attention to the changes or resistance to change taking place in the bald vegetation. Perhaps the most lively and controversial subject of most papers is the question of bald origin (Gersmehl's 1970 study reviewed and evaluated most earlier papers in this respect). Most studies have been observational, often linking present with past data on changes observed (Harshberger 1903; Cain 1931; Camp 1936; Wells 1936a, 1936b, 1938, 1946, 1956; Brown 1938; Gates 1941; Gilbert 1954; Whittaker 1956; Billings and Mark 1957; Mark 1959; Bruhn 1964; Kring 1965; Gersmehl 1970, 1971; Lindsay 1976; Ramseur 1976; Lindsay and Bratton 1979b; and Sullivan, et al. 1980). Manipulative studies are fewer and require longer-term commitment by the invesitgator. One of the earliest efforts to determine establishment of spruce and fir in grass balds was conducted by Brown (1953) with Mark's (1958a, 1958b) studies on seedling establishment close behind. More recent studies were reported by Lindsay (1977), Barden (1978), and Lindsay and Bratton (1979a). In a less formal way, preliminary manipulations have been conducted by the U.S. Forest Service at Roan Mountain, the eastern portion of the Balsam Mountains and other portions of both Pisgah and Nantahala National Forest areas, and the Mount Rogers National Recreational Area (cf. Lindsay 1977, p. 67 for unpublished reports available). Preliminary efforts were attempted at Craggy Gardens on the Blue Ridge Parkway to restore and maintain the purple

rhododentron heath balds (Larry Freeman, 1975, personal communication). Further studies directed toward documentation and future management of heath and grass balds at Craggy Gardens are underway (Smathers 1979).

Bald Maintenance

It is well established that grass or heath balds are not static plant communities. While the question of their origin has not been satisfactorily answered, it is generally agreed that some form of manipulation of the succeeding plant communities is required. Among natural manipulations are physical factors, such as droughty soils, exposure to sun and wind, fire, and the like; other natural manipulative factors would include the involvement of biological factors, including root competition, chemical inhibition, etc. Artificial manipulative factors can also maintain grass or heath balds. Among these are clearing, grazing, burning, or any other activities controlled or initiated by humans.

The presence of the natural physical pressures have been emphasized by some (see Gersmehl's review of literature up to 1970; Sullivan, et al. 1980). Included among these physical factors are severity of exposure, a frequent subject in the literature (Ziegler and Grosscup 1883; Harshberger 1903; Davis 1930; Camp 1936; Brown 1941; Whittaker 1956; Ewan and Ewan 1963; Gersmehl 1970; and Sullivan, et al. 1980). Another physical factor could be fire (see Yard 1942; Gersmehl 1970; Barden 1978; Lindsay and Bratton 1979a, 1979b). Edaphic factors could also contribute to bald maintenance (Davis 1930; Cain 1931; Fink 1931; Brown 1941; Gilbert 1954; and Gersmehl 1970).

Many investigators reasoned maintenance was of biological origin. Root competition by mountain oat grass (Danthonia compressa) was suggested by Wells (1936b) as preventing spruce and fir or other species from becoming established. Some type of inhibition by blackberries was suggested by Korstian (1937), but Gersmehl (1970) noted spruce and fir seedlings in

blackberry stands at Judaculla Fields of Richland Balsam Mountain. Chemical phytotoxins are produced by many plants; for example rhododendron has been reported by Gant and Clebsch (1979) to inhibit test plants. Grazing and browsing contribute significantly to grass bald maintenance (Yard 1942; Billings and Mark 1957; Gersmehl 1970; Lindsay 1977, 1978; and Lindsay and Bratton 1979a, 1980). Lack of adequate spruce and fir seed sources could encourage bald maintenance (Billings and Mark 1957; Mark 1958a; Gersmehl 1970; and Sullivan, et al. 1980).

Human activities, including slashing and burning, grazing, etc., are indicated as maintemance factors by most investigators (see Gersmehl's review up to 1970; Barden 1978; Lindsay and Bratton 1979a, 1979b). Certainly there has been prehistorical as well as historical attraction of humans to these open areas of low vegetation.

It has become abundantly clear that the origin and maintenance of balds in the southern Highlands cannot be explained by one set of factors. Perhaps the complex of factors vary from site to site, such that any one set would not be applicable throughout the region.

Succession

Since the balds are dynamic and subject to change in vegetation patterns, a brief description of some successional trends is appropriate. Many of the grass balds have been documented to be in existence for nearly a century without significant alteration. This is true of the larger balds, such as Round Bald of the Roan Mountain area. All balds studied, however, show evidence of encroachment along their periphery. The sequence of plant invasion, while following certain patterns, is varied.

Most areas in the grass bald condition have heath succeeding the grasses. Frequently lowbush blueberry (Vaccinium vacillans) colonies occur in circular clusters scattered across the grassy expanses. These may be followed by highbush blueberry (V. constablaei), purple rhododendron (Rhododendron catawbiense),

or mountain laurel (Kalmia latifolia). Sometimes flame azales (R. calendulaceum), Cumberland azalea (R. bakeri), clammy azalea (R. viscosum), or smooth azalea (R. arborescens) invade the grassy areas (at Gregory Bald the latter three have hybridized into myrids of forms and colors). Minnie bush (Menziesia pilosa) is sometimes observed encroaching into the grassy areas, as at Graveyard Fields along the Balsam Crest.

Second to the heaths are blackberries (mainly Rubus canadensis), perennial herbs, and a few other shrubs. Blackberries normally become established in burned areas. Burns are also suitable for establishment of bush honeysuckle (Diervilla sessilifolia) and the herbaceous angelica (Angelica triquinata. At the Roan Mountain area extensive colonies of the southern-most extension of green alder (Alnus crispa) are expanding into the grassy areas.

Trees become established in grass balds, sometimes in the open grassed areas, but often among the shrubs. Beech and birch forests are known to encroach into grassy areas, as in the Craggies. Fire cherry (Prunus pensylvanica) commonly follows fires, as in the Graveyards area. Mountain ash (Sorbus americana) has become widely established in the Craggies and Devils Courthouse area near Beech Gap in the Balsams, in the latter case following fire. Spruce (Picea rubens) and Fraser fir (Abies fraseri) typically spread into grass balds along the margins (as in Judaculla Fields) but clusters may occur and spread from established isolated trees, as can be noted in the Graveyards area and at Judaculla Fields. Sometimes scattered hawthorns (Crataegus flabellata and C. punctata) are invading grass balds, usually those pastured. Northern red oak (Quercus rubra var. borealis) is invading the grassy areas, as at Old Fields in the Balsam Mountains.

CONCLUSIONS

Grass and heath balds are continually changing. This change has resulted in a significant decrease in the grass bald extent in the Southern

Appalachians during the historical recording of such areas. Gersmehl (1970) concluded that nearly half (56) of the former 119 grass bald sites have become forested since their first mention in documents. This trend can be expected to continue unless significant maintenance manipulations are undertaken. Heath balds may replace grass balds in many areas but the successional communities often vary from site to site. Purple rhododendron, for example, may occur at one location, a mixture of other heath species at another location, and trees such as fire cherry may develop in another grass bald.

Before a comprehensive management plan can be developed documentation and experimentation must be undertaken. While most of the significant bald sites have been tabulated by Gersmehl (1970), updating of his information using recent aerial photographs and field evaluation is needed. Some method of estimating successional status, extent of bald communities, rate of invasion, ownership, projected uses, etc. seems desirable. It would seem reasonable to attempt experimental techniques other than those recently attempted by Lindsay (1977); such as burning, or perhaps utilizing other types of herbivore grazers and browsers, such as bison and elk. In any case, it will be wise to prescribe management procedures for each site, based on the variation of the site characteristics and bald features desired.

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VALUES AND PUBLIC AWARENESS OF SOUTHERN APPALACHIAN HIGH MOUNTAIN BALDS

Robert Proudman
Appalachian Trail Conference
Harpers Ferry, WV 25425

INTRODUCTION

This paper examines the recreation values and public awareness concerns of the Southern Appalachian high mountain balds. More specifically, it examines the directions and obligations of land managers to perpetuate the biological characteristics of these unique lands, while encouraging select types of public recreation use through improved trail design, with education and interpretation in the field.

Three basic values compete with each other in the management deliberations of policy makers concerned with mountain balds. The first is the obvious resource or biological values in these unique areas, the second is the recreation values to hikers and backpackers, who seek the sublime experiences available on these highly scenic lands, and the third is the need to insulate these areas from the negative attributes of consumptive-value recreation, such as off-road vehicles. In the conflicts that arise between these values, managers must face difficult choices in order to assure compatible recreation use and biological protection of high mountain balds. There may be uncomfortable polarization of views that endangers the political vitality necessary for future preservation and management of these areas.

THE RECREATION VALUE OF BALDS TO HIKERS

A sure indication of the recreation value of balds to hikers and nature lovers can be found in an often overlooked source: participant literature. These stories and first hand accounts, written by and for users in the Appalachian Trailway News published by the Appalachian Trail Conference, Harpers Ferry, West Virginia, are replete with grandiose descriptions of the beauty and serenity of the high mountain balds. The reputation of the Rhododendron Bloom on Roan High Mountain Bald or Hybrid Azalea on Gregory Bald is almost common knowledge among trail enthusiasts, even in far off New England. People who plan to, but have not yet visited the balds, anticipate the prospect as much as the event itself. This pervasive knowledge demonstrates an advanced sense of value for these lands. There is an obvious publie awareness here, even if limited to the recreation interests of hiking and backpacking. Hikers are profoundly rewarded by their experiences on balds, which may include flower study, openness, and panoramic scenery. The latter is heightened precisely because of the rarity of open landscapes along the prime travel route, the Appalachian Trail (personal communication with numerous through hikers on the Appalachian Trail).

CONFLICTS BETWEEN RESOURCE AND RECREATION VALUES

This popularity has had negative impacts on some balds. Physical impacts on the resources of soil and plant life have followed increased trail use (Proudman 1977). Most land managers are familiar with the dilenma brought about when the beauty and reputation of an area attracts enough recreation use to cause resource deterioration. It is an irony that the recreation values, burgeoned by excessive and enthusiastic participation, damage their own reason for existance; the scenic and biologically unique value of high mountain balds.

In the worst cases, this conflict between the land and its visitors permits subtle resource deterioration because hiking is traditionally viewed as a benign and compatible land use. This continues until both managers and visitors realize, usually too late, that the dual objectives of biological protection and social recreation can work at cross purposes.

In 1976 I organized a trail crew that worked on the Roan Highlands, Pisgah National Forest, between Carvers Gap and U.S. Highway 19E.[1] The Southern Appalachian Highlands Conservancy, a local conservation group familiar with our trail hardening and drainage techniques in the alpine areas of northern New England, solicited our help. The problems of alpine zones and balds were similar, although the two environments are each completely unique. In both cases, the impacts were characterized by trail erosion and widening on the steepest slopes. The scenic and open character of both alpine areas and balds make for endemic problems such as short-cutting by hikers on the inside of turns and switchbacks, excessive trampling of soils, and fire rings and litter at popular gathering spots and camping zones (this latter problem develops despite regulatory sanctions). In the worst cases, it is as if the very beauty of such areas sows the seeds of its own overuse and misuse, by being "loved to death". This paradoxical situation is a common condition in the most scenic and popular areas in the parks and forests of the nation. It is fascinating to study as a value conflict between preservation and recreation use.

The trail work installed during this project in 1976 was partially successful. The worst erosion was stabilized with the installation of steps and

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1 A cooperative agreement between the Appalachian Mountain Club; the Southern Appalachian Highlands Conservancy; and Pisgah National Forest, U.S. Forest Service.

waterbars. Trail widening was contained through re-routing the trail where it was arbitrarily circuitous, and preventative installation of drainage has abated new erosion. The building materials, usually native rocks and logs, were absent in many places and had to be imported with horse teams. This resulted in an aesthetic problem because the most impacted areas had a constructed appearance that was disconcerting to the environmentalists who originally solicited our assistance. Though this construction has since weathered a color change and appears less noticable, managers should be forewarned that such trail cures can often assault the values they are meant to protect, at least in the first few seasons following the work. We now hear that the work have been helpful, and the only problem is a need for additional trail construction both to reestablish the old work, and to install new erosion-abatement techniques in other areas. Although there are obvious similarities between alpine areas and balds, especially in the results of their recreation use, it may be instructive to also recognize their distinctions. Alpine terrain is characterized by a short growing season, low ambient air and soil temperature, wet and highly fragile soils, and plant life in a distinct botanical regime characteristic of extreme northern latitudes. Southern Appalachian balds have a longer but cool growing season; higher air and soil temperatures; moist, deeper, and sometimes rocky soils; heavy precipitation year round; and plant life consisting of grasses, herbs, and shrubs usually surrounded by hardwood or spruce-fir forests. It seems apparent that if comparative studies of carrying capacity were done, the relative hardiness of the southern balds would become obvious. My personal observations are that trail impacts on the scale of the Roan Highlands are a relatively rare condition on southern balds. But land managers should recognize trail deterioration to guarantee early and preventative trail care, especially in the most popular recreation areas.

CONFLICTS BETWEEN DIFFERENT TYPES OF RECREATION VALUES

Beyond the recreation resource conflict described above, there is a conflict of growing concern between different types of trail recreation. Hiking, horseback riding, and off-road vehicle (ORV), riding have become the main protagonists in this park policy confrontation. The term "park" is used generically here, to include all public and private lands reserved for trail recreation. The conflict is largely one of two different and distinct systems of recreation values, with profound implications far beyond the apparent competition for park space that comprises the surface of the debate. In its largest implications, this conflict, which draws its battle lines between pedestrian recreation such as hiking and backpacking, and motorized recreation, is a conflict of recreation values between two distinct types of people in our society. Their respective recreation values are as different as their educational backgrounds, and as different as their work environments as either "white collar" managers or "blue collar" laborers. (Sax 1980, p. 48). The values and physical characteristics of each group's preferred recreation activity merit comparison, to understand and therefore begin to resolve the public policy disputes that beg for answers. Knowledge, empathy, and cooperation between the opposing parties is the most productive course for park policy makers to encourage.

The greatest battles between the ORV interests and the preservationists, (who claim to represent the hiking community), have been in the West, where television coverage of events such as the California desert racing involving thousands of motorcycles, dramatizes the extremes to which the ORV phenomenon has grown. Fortunately for Eastern hikers, the tree-covered landscape has prevented motorized activity on this scale. However, one could conjure up

similar situations between the Western experience and the open character of the Eastern Mountain balds. Both of these open landscapes are a clue to their particular susceptibility to the values of ORV recreationists. Enforcement problems with ORV use on open areas, like balds, despite legal restrictions on motorized recreation, would seem to be an endemic condition that will not be easily solved by land managers.

CONTEMPLATIVE RECREATION VALUES

Hiking, and especially its offshoot, backpacking, appears to be an arduous and uniquely painful activity to the nonparticipant. First experiences with the sport can be characterized by unrelieved misery and exhaustion in primitive and remote environments. As experience grows, the persistant beginner finds that, with skill his pack lightens, and his ability to anticipate and improvise permits a highly satisfying control of his experience. He takes pride and even exalts his maturing recreation values, a set of expectations most often opposed to rather than associated with modern amusements such as television and auto touring. These hiking values include an active immersion in potentially hostile environments that give rise to a positive satisfaction from the adaptive use of one's personal resources. Hikers have an extremely good time in a deeply healthy and profoundly comtemplative manner that requires scenic, wild, and natural park environments free from motorized activity. These values have been well documented in the writings of such nineteenth century nature prophets as Thoreau and Muir. They have been further refined and applied to modern social conditions by twentieth century writers such as Frederick Law Olmstead, Aldo Leopold, Edward Abby and, most recently Joseph L. Sax (1980, p. 17-34). These writings articulate recreation values that include freedom and independence, self-imposed constraints known collectively as "sportsmenship", competition with oneself rather than with each other,

participation in small groups such as with families and friends, and most important, a series of expectations that approach that of secular religion, with profound naturalistic symbolism and moral overtones.

These values are not by any means exclusive to hiking. Mountain climbing, fly-fishing, crosscountry skiing, and bow-hunting are all common derivatives of what might be accurately called contemplative recreation values. These values have historically formed the philosophical basis for the national parks and, although they do not establish a coherency that exists behind other institutions such as those in law or business, they are very real and worthy of greater study, use, and organization, especially in their application as park policy.

These preservationist ideals are obvious in the Wilderness movement, where great effort is expended to narrow management options on Federal land and eliminate the use of motorized equipment and multiple use programs such as timber harvesting. Their political efforts are sometimes masked as concern for the environment, with legal challenges filed under the provisions of the National Environmental Policy Act. While they are concerned with physical impacts, I would submit that this is only a legal rationale for their real mission on public lands; to insist on legal protection for a contemplative, quasi-religious, and moral value system. Though the preservationists might therefore appear elitist, as has often been accused, they seem to welcome and encourage participation by people in all walks of life. Their strong, common conviction was accurately described by Henry David Thoreau over a hundred years ago when he stated, "In wildness lies the preservation of the world."

CONSUMPTIVE RECREATION VALUES

Riding powerful off-road vehicles such as snowmobiles or motorcycles, has become an increasingly important pastime for many Americans. Snowmobile clubs have sprung up in many rural snowbelt communities. Organized motorcycle riding events such as "enduros" have become more common. Participation by unassociated individuals has sprung up on the margins of many parks. These recreation activities are not only the result of technological advances, but also social changes brought about by the dehumanizing influences of the modern workplace (Sax 1980, p.47). The participant, too long and too often the victim of boredom, needs a titillating, agressive, and power-oriented leisure-time outlet. He has something to prove, a need, and even a right to prove it. The problem arises however, in his need for space and therefore, his claim to diminishing public and private open space, especially if that claim exaccerbates the difficulty of choice already posed by the biological rarity of places like the Southern Appalachian high balds.

QUESTIONS FOR RECREATION CONFLICTS RESDUTION

The conflict between hikers and the ORV has been addressed on some public lands. President Nixon issued an executive order mandating Federal landholding agencies to open, close, or zone ORV use. National parks and the Appalachian National Scenic Trail have specific limitations in law and regulations regarding ORV use (National Trails System Act, 82 (919), sec. 7(c); Code of Federal Regulations, Title 36:2.30). Many states, especially in the snowbelt, have developed model statutes for licensing, control of noise levels, and capital-facility investment in ORV-trail systems. These efforts, though comendable, still fall short of solving the moral predicament of mechanized use of public lands which were historically preserved for their biological and natural values.

It seems that much greater emphasis on educational and interrpretive efforts is warranted, especially for the nontraditional park audiences such as ORV users. Why is it that they find less consumptive recreation values so hard to adopt? Would they be more willing to control their impulses to ride on the balds if they were exposed first, and on foot, to the sublime and silent beauty of the Rhododendron bloom in the moonlight? What is our larger social obligation as researchers and land managers to treat the casual factors behind recreation conflicts rather than the symptoms of illegal ORV access? Are legal solutions a partial cop-out which ignore and even alienate the legitimate interests of the ORV-rider? Why do European countries have trail clubs numbering over a hundred thousand members, and with no apparent conflict similar to the American experience? Will we empathize, share and cooperate or will we continue special-interest policy making, balkanizing both our parks and our park managers?

These questions are asked rhetorically and are not easily answered here. They address broad issues beyond the scope of Southern balds management. However, it is evident that the future of at least some of these areas is inextricably related to the evolution of these value conflicts, and the questions they force us to pose to ourselves, and to each other.

CONCLUSIONS AND RECOMMENDATIONS

Resource and Recreation Value Conflicts

A. Multidisciplinary Management

Many roads and trails of the past have lacked deliberate routing. They often exhibited a perfunctory relationship with the land, especially its biological characteristics. As the sole access to extremely valuable landscapes, they now warrant planning and design equal to the values they exhibit. Greater skill with trail manipulation must be demanded, even to the point of initiating a whole new area of specialization, that mixes landscape architecture with other disciplines, to form a new cadre of multidisciplinary specialists equal to the task.

Greater cooperation should be invested on multidisciplinary management of balds, involving both botanists and trail designers. Too often the scientist, with an absolute commitment to biological values, abhors trails and the impacts they bring, especially if they affect endangered plant life. This position can blind him to the inevitable continuation of deleterious public use. Cooperation with skilled designers can bypass the most sensitive and unique biota of an area. Correspondingly, the trail designer has the obligation to solicit botanical advice to avoid inadvertent damage to rare species during trail routing and maintenance activities.

B. Field Productivity Problems

Both mechanical removal of woody growth necessary to preserve historical bald condition, and trail construction and maintenance require costly hand-labor. Too often this expense is perceived as prohibitive

when in fact it is simply being conducted inefficiently. Poor field leadership, and a lack of skill with or maintenance of, hand tools, leads to a ludicrous waste of public resources.

I would wager that the most hand labor in recent years has been executed with the wrong, oversized and rarely sharpened tools, rather than wielded with the skills of the workers in the Civilian Conservation Corps of the 1930's. The resulting gap between work needs and capabilities leads to biological and recreational forces being out of control. This spawns policy conflicts out of proportion with the actual field work liabilities on the grounds. Improved training for relearning hand tool techniques, improved hand tool design and maintenance, and new personnel programs that solicit motivated workers and reward expertise rather than longevity, can increase productivity and assure a practical field protection of high mountain balds. Young people and the currently skilled volunteers can be led in a much more practical manner than has heretofore been evident.

CONTEMPLATIVE AND CONSUMPTIVE RECREATION VALUE CONFLICTS

A. Education and Interpretation

The value conflicts existing on public park land will perhaps never be fully solved until there are social changes in the American workplace. There should be efforts in the interim, however, to enlarge the appreciation of outstanding natural environments such as the Southern Appalachian Balds.

Efforts to expose non-traditional publics to the uniqueness of the balds are desirable. Park interpretive programs often preach only to the converted park visitor who already appreciates the contemplative values. Would there be a long term benefit if the preservationists

provided trip leaders to the Boy Scouts or to rural 4-H programs? Would joint programs between environmentalists and rural churches help bridge the gap? Is there a way to establish programs with local rural communities near the balds? Might we encourage ORV enthusiasts to form clubs, thereby capsulizing an audience that would profit from our enthusiastic presentations? These same clubs might help locate legitimate outlets for ORV use in areas that can withstand their use. Then, peer pressure rather than expensive law enforcement could be brought to bear on ORV law breaking.

Ridgerunners and caretakers, trained, and selected for their interpersonal skills, have been very successful on Northern segments of the Appalachian Trail, where they reside on the Trail, talking to people during the summer season. Why are there no similar programs in the South? Land managers seem exasperated with the dilapidated conditions of overnight use areas such as shelters and campsites. Yet if only 10% of the onsite care available at roadside visitor centers was available at these shelters in the form of caretakers, such problems would be eliminated. We must transfer some of our paid human resources out of the office and off of the park road systems, and onto backcountry trails.

B. Design Solutions

Greater research and development is needed to design effective barriers to selected types of use. There should be a study of the use of visual and accoustical screening that would isolate and therefore protect the most valuable biological and recreational land attributes. Engineering research and development might propose some lowcost, effective fence barriers, with stiles for hikers and grazing animals. Eventually the land manager would have a series of standard design and construction

alternatives available to enhance the breadth of alternative decisions, such that access is provided but without unforeseen impacts on the physical and social resources of the area. We need to sort out users, and decrease their ability to penetrate important park locations. This would provide a deliberate control, but a benign rationing of park access. A merit system, based solely on the initiatives of the user, would determine the success of his visit. This would protect biological values, reduce the arbitrary nature of park capacities and permits, and strengthen the exercise of user free-will, the most important of the contemplative recreation values.

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THE FLORAL VALUES OF SOUTHERN APPALACHIAN BALDS

Edward Schell
Tennessee Native Plant Society
Johnson City, TN 37601

INTRODUCTION

To anyone who has ever witnessed the blooming of flame azaleas on Gregory Bald, there is little reason to ask "What is the importance of the Southern Appalachian balds?" It must seem a strange question to one who has viewed the massive blooming of Mountain Rosebay at Craggy Gardens or Roan Mountain, or to one who has waded knee-deep in the grasses of Big Yellow. To these people, the worth of these special islands in the sky is self-evident. Where else can one stand in "a vast meadow without a tree to obstruct the prospect" and view "a green ocean of mountains raised into tremendous billows immediately about him", as Elisha Mitchell (1935) described the scene. And yet the question is asked, and I will try to give you a layman's answer.

My personal knowledge of botany and bald ecology is the kind that results from a passionate enjoyment of Nature. As such, it may lack the scientific finesse of the well-trained botanist. Further, my knowledge of balds other than those of the Roan Mountain massif is quite limited. I shall, therefore, confine most of my observations to these particular balds and freely confess that they may or may not apply to other balds.

A SPECIAL PLACE FOR PLANTS AND ANIMALS

The balds of the Southern Appalachians are usually divided into two kinds, heath balds and grass balds, with the former consisting mainly of ericaceous shrub species such as the rhododendrons, azaleas, and blueberries, and the latter composed of herbaceous plants with grasses and sedges predominating.

Heath Balds

The heaths are a tough, wiry group of species that seem to thrive in the face of adversity. Where there are extensive heath communities, there are usually extreme environments. Low temperatures and howling winds produce chill equivalents far below the actual temperature. Heavy snows and severe icing weigh the heaths down in winter. With their tough, flexible branches and twigs growing close to the ground, they have, through the long course of evolution, adapted themselves to this important ecological niche where other species fail.

Typical plants of the heath balds include Mountain Rosebay (Rhododendron catawbiense), Flame Azalea (Rhododendron calendulaceum), Mountain Laurel (Kalmia latifolia), Minniebush (Menziesia pilosa), Sand Myrtle (Leiophyllum buxifolium), Blueberries (Vaccinium. spp.) and Mountain Cranberry (V. erythrocarpum) in the heath family. Other shrubs often include Black Chokeberry (Sorbus melanocarpa) and Mountain Alder (Alnus crispa). The almost pure stands of the alder are sometimes referred to as alder balds and occur only on Roan Mountain.

The understory of the heath balds provides a haven for many other species, including fungi, lichens, lycopods, ferns and many herbaceous species. For

example, these shrub balds on Roan Mountain often provide good habitat for the strikingly beautiful Appalachian Avens (Geum radiatum).

Grass Balds

The plants of the grass balds often have to face the same environmental extremes as those of the heath balds. These grasses and sedges would seem by comparison with the heaths, to be quite delicate and vulnerable. But nothing could be further from the truth. Grasses are among the most adaptable of all the members of the plant kingdom. From the chill heights of mountains beyond treeline to the waters under the sea, from the frigid tundra to equatorial heat, from shaded woodland to burning desert, there are few habitats which do not have grasses. They may well be the most versatile of the flowering plants with respect to habitat requirements.

In July of 1889, F. Lamson Scribner (1889) recorded 25 species of grass on "Roane" mountain, "all.....over 6,000 ft." elevation. Scribner's list included several species which may not be there today, and some which were not on the balds. But most of those he saw have been rerecorded in the last fifty years. A recent compilation by Tom Gatti (1977) notes 20 species of grasses and 11 species of sedges which occur on the balds.

These are important sources of food for many of the fauna on the mountain and along with other herbaceous species provide sustenance for northern mammals and birds. For example, Snow Buntings (Plectrophenax nivalis) are regular visitors during the winter on the Roan and Big Bald. A study by the late Fred Behrend showed the Snow Buntings to be feeding on the seeds of Three-toothed Cinquefoil (Potentilla tridentata) and other grass bald species (Brook 1965). These high elevation grasslands have environments similar to the artic tundra and wind-swept beaches of the northeastern coast. The New

England Cottontail (Sylvilagus fontinalis) also finds browsing areas around the edges of the balds.

In recent years, the grass balds have been invaded by the Thornless Blackberry (Rubus canadensis). Growing in almost pure stands, this northern species is a fierce competitor. The grasses also seem to be giving way to the sedges. This is a personal judgement based on discussions with several botanists and published papers describing the flora in bygone times.

Many other species of herbaceous plants occupy this open sunlit habitat. A catalog of plants of the grassy balds is beyond the scope of this short paper, but Mark (1959) has published such a list. To my knowledge, the heath balds have not been treated similarly. To mention a few of these, the grass balds contain good populations of Bluets (Houstonia serpyllifolia), Dwarf Cinquefoil (Pontentilla canadensis), Strawberries (Fragaria virginiana), Angelica (Angelica triquinata), Pale Indian Plantain (Cacalia atriplicifolia), numerous Asters (Aster spp.) Goldenrods (Solidago spp.) Rattlesnake Roots (Prenanthes spp.), Ragworts (Senecio spp.), and many other composites. Several species of ferns and clubmosses are found on these balds as well as the true mosses.

Another important aspect of the grass bald is the "edge effect" where the bald meets the forest. Over the distance of 10 to 30 yards or so, one of the richest ecosystems in nature exists. It is in this region of shrubs and dense cover that many species of mammals and birds find their best existence. In this habitat ornithologists recently discovered the southernmost breeding record for the Alder Flycatcher (Empidonax alnorum) (Lura, et al. 1979). It is a very important habitat for many plant species as well.

In general, these balds offer an open high altitude habitat and are havens for many of the more northern sun-loving species found in the south.

ENDANGERED, THREATENED AND SPECIAL CONCERN PLANTS

The balds harbor several species that botanists and conservationists feel are in danger because of habitat losses, exploitation, and other causes. A listing in Table 1 from balds of the Roan Mountain Area shows these species for North Carolina, (North Carolina Museum of Natural History 1975) Tennessee (Collins, et al. 1978) or both.

ESTHETICS OF THE BALDS

These balds of ours are among the finest natural areas to be found in all the eastern mountains. As such, they attract nature enthusiasts from many states. On Roan mountain the Carter County Wildflower Tour takes place in late April, and two rhododendron festivals occur on successive weekends in June and July. In September, on the weekend after Labor Day, the annual Roan Mountain Naturalists' Rally brings both amateur and professional naturalists from many states and several foreign countries to appreciate and enjoy the flora and fauna of the balds. School groups and other organizations use the balds for field trips throughout the year.

There is no more worthy reason for the existence of these balds than the intense beauty of the many floristic displays. Flame azaleas in June come in every shade from lemon yellow to brilliant red. As the azaleas pass, the delicate pinks of the Mountain Rosebay cover the wild gardens and rhododendron slicks on the ridges. Robbins Ragwort dots the balds with showy yellow patches, and the Roan Bluet mats the thin soils near rock outcrops. Although its

TABLE 1. LIST OF SPECIES FROM NORTH CAROLINA AND TENNESSEE BALDS SHOWING THEIR STATUS AS ENDANGERED, THREATENED, OR SPECIES OF SPECIAL CONCERN.

SCIENTIFIC NAME	COMMON NAME	STATES	
		NORTH CAROLINA	TENNESSEE
Agrostis borealis	Arctic Bentgrass	E	E
Alnus crispa	Mountain Alder	T	T
Arenarea groenlandica	Mountain Sandwort	T	T
Geum radiatum	Appalachian Avens	E	E
Houstonia montana	Roan Mountain Bluet		E
Hypericum graveolens	Mountain St. John's-wort		T
Hypericum mitchellianum	Mt. Mitchell St. John's-wort		T
Lilium grayi	Roan lily	T	T
Lycopodium selago	Fir Clubmoss	T	T
Menziesia pilosa	Minniebush		S
Paronychia argyrocoma	Silverling		E
Potentilla tridentata	Three-toothed Cinquefoil	T	S
Prenanthes roanensis	Roan Rattlesnakeroot	T	T
Senecio robbinsii	Robbins' Ragwort	E	E
Trisetum spicatum var. molle	Narrow False Oat	E	E

STATUS SYMBOLS: E = ENDANGERED T = THREATENED S = SPECIAL CONCERN

greatest bloom is in early May, one can see the showy pink buds and white blossoms of Sand Myrtle eight months out of the year. The orange-red bells of the Roan Lily are at their best in early July, and Mountain Dandelions cover the rocky outcrops throughout the summer. Close by, the tiny goblets of Mountain Sandwort crowd the rocky edges with dense mats of flowers and foliage. Late summer brings the blooming of the showy asters, and the bright yellow wands of Mountain Goldenrod array themselves along the trail.

On these balds, we stand in awe before the creations of Nature. We marvel at the infinitely superior wisdom embodied in the process of natural selection. The preservation of these values, the protection of these special places, for ourselves and from ourselves, must be our prime concern for as long as Nature wills.

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ANIMALS OF A BALD IN WESTERN NORTH CAROLINA

Thomas D. Robinson
Scott Paper Company
Citronelle, AL 36522

INTRODUCTION

A "bald" is a largely herbaceous plant community located at 1500-1800 meters (m) (4900-6000 feet) elevation (Barden 1978). These open areas are usually surrounded by forest or shrubby vegetation. Balds are scattered through the higher parts of the Southern Appalachians from Virginia to Georgia (Gersmehl 1970).

The origin of balds is uncertain. Lightening-caused fires (Clements 1936), gall wasp (Callirhytis spp.) infestations (Gates 1941), and past climatic changes (Whittaker 1956, Billings and Mark 1957) have been linked to the formation of balds. Gersmehl (1970) reviewed previous studies and concluded that balds were artifacts of the burning, grazing, and logging activities of the settlers. A recent study by Lindsay and Bratton (1979) of balds in Great Smoky Mountains National Park revealed that some balds were cleared by early settlers; the origin of others was not determined.

Regardless of their origin, these unique areas attracted the interest of hikers, botanists, and ornithologist. The hikers appreciated the beautiful vistas afforded by the treeless areas. Botanists were attracted by the varied plant communities (Ramseur 1960). Knickerbocker (1974) reported that these grassy areas were preferred by ravens (Corvus corax) and wintering golden eagles (Aquila chrysaetos).

As balds were studied, their vegetational composition was observed to be gradually changing. Just as old fields succeeded from bare ground to forest over the years (Oosting 1942), balds also followed a successional pattern. They gradually changed from herbaceous to predominantly woody vegetation. Succession was slow due to the harsh climate and lack of an adequate seed source for shrubs and trees (Billings and Mark 1957, Gersmehl 1970).

Since balds have many unique qualities which succession would change, federal land managers employed methods to limit the encroachment of woody species on these grassy areas. Prescribed fire (Lindsay 1977, Barden 1978), grazing, cutting, and mowing (Lindsay and Bratton 1979) were all effective means of arresting growth of woody vegetation. In a pilot project, the U.S. Forest Service (U.S.F.S.) in western North Carolina chose prescribed fire to retard woody growth on balds.

In 1973, the U.S. Forest Service started a prescribed burning program on selected balds in the Pisgah National Forest. Most of these areas were classified as shrub balds due to the large amount of shrubs growing on them. The aim of this program was to increase the amount of grassy areas as potential habitat for ravens and overwintering golden eagles.

Barden (1978) studied the effects of prescribed fire on the vegetation of these balds. He determined that, despite browsing by white-tailed deer (Odocoileus virginianus) and eastern cottontails (Syvilagus floridanus), a 5 to 8 year burning cycle would be necessary to maintain a grassy area.

As a follow-up study, the effects of controlled burning on the mammals of the same bald were determined (Robinson 1980). The one year study had the following objectives:

1) determine populations and species diversity of small mammals on a shrub bald;

2) determine the effects of prescribed burning on populations and species diversity of small mammals on a shrub bald; and,

3) determine seasonal relative abundance of white-tailed deer and eastern cottontails on a shrub bald.

Additionally, a checklist of mammals of the area was compiled. Birds were censused periodically.

STUDY AREAS

In western North Carolina near Tennent Mountain in the Balsam Mountains (35° 20' latitude, 82° 52' longitude), three areas representative of unburned shrub balds, burned shrub balds, and spruce-fir forests were selected for study. This high elevation area was once covered by spruce-fir forests; but, the early 1900's clearcutting removed most of the original forests. Major wildfires occurred in 1925 and again in 1942. These fires destroyed all but remnants of the spruce-fir regeneration. Herb-shrub and fire cherry communities developed and maintained themselves after 1942 (Barden 1978).

In November, 1975, U.S. Forest Service personnel prescribe burned several areas in an effort to retard woody plant succession. The prescribe burned area was a 65 hectare (ha) tract located at 1700 m elevation. The unburned study area was located at an elevation of 1700 m and was approximately 30 ha in size. This site resembled the burned area prior to the 1975 prescribed fire (personal communication, 1979, Mr. Ben Sanders, wildlife biologist, U.S.F.S., Asheville, North Carolina). The spruce-fir forest study area was the climax vegetation of this high altitude area. This 40 ha site had an elevation of 1730 m.

The aspect on the burned and unburned areas was southern; the spruce-fir area had a southwestern aspect. All areas had moderate slope ($\leq$ 10%). The predominant soils in the areas were Porters and Burton stony loams (Goldston, et al. 1954; King, et al. 1974).

VEGETATION

Structure and composition of vegetation differed greatly between the 3 study areas. The unburned shrub bald had a closed canopy of 5-8m tall fire cherry (Prunus pensylvanica). Beneath the trees was a dense stand of blackberry (Rubus sp.) which suppressed other ground cover. The burned area lacked an overstory but had a dense, grassy ground cover (Danthonia compressa and Carex sp.). These grasses were interspersed with blackberry thickets and blueberry (Vaccinium spp.) bushes. In the spruce-fir area, only a sparse herbaceous cover existed under the 20 m tall evergreen canopy. Species composition was similar in the unburned and burned shrub balds; the spruce-fir forest shared few species with the shrub balds.

RESULTS AND DISCUSSION

In the following discussions, a brief account of the methods of each part of the study will be given. Detailed methods are found in Robinson (1980).

Small Mammal Trapping

Sherman live traps (8x8x25 cm) were used for trapping small mammals. Captured animals were marked and released. Trapping was accomplished during October, 1978, and April and June, 1979. Adverse weather conditions prevented trapping during the 1978-79 winter.

Trap effort totaled 4601 trap-nights during the study. Table 1 list the species, number of individuals, and rank order based on that number of individuals captured during the study. The four most abundant species captured were,

TABLE 1. SMALL MAMMALS CAPTURED IN THREE HABITAT TYPES IN WESTERN NORTH CAROLINA.*

SPECIES	UNBRUNED SHRUB BALD	BURNED SHRUB BALD	SPRUCE-FIR FOREST	TOTAL
Sorex cinereus	7(3)**	13(3)	16(3)	36(3)
S. fumeus	-	-	3(6)	3(8)
Blarina brevicauda	1(7)	1(6)	2(7)	4(7)
Tamias striatus	1(7)	-	-	1(9)
Tamiasciurus hudsonicus	1(7)	-	7(5)	8(6)
Peromyscus maniculatus	36(1)	19(1)	71(1)	126(1)
P. leucopus	25(2)	17(2)	11(4)	53(2)
Neotoma floridana	-	-	1(8)	1(9)
Cleithronomys gapperi	3(6)	3(4)	22(2)	28(4)
Microtus pennsylvanicus	-	1(6)	-	1(9)
Synaptomys cooperi	1(7)	2(5)	-	3(8)
Zapus hudsonius	4(5)	-	-	4(7)
Napeozapus insignis	5(4)	1(6)	3(6)	9(5)
TOTALS	84	57	136	277

*Nomenclature follows Jones, et al. (1975)

**Number of individuals (rank order)

respectively, Peromyscus maniculatus (deer mouse), P. leucopus (white-footed mouse), Sorex cinereus (masked shrew), and Cleithronomys grapperi (boreal red-back vole). The composition of the small mammal community varied for each area.

The small mammal community of the unburned shrub bald was dominated by Peromyscus maniculatus and P. leucopus. Over two-thirds (61 of 84) of the individuals captured were Persomyscus spp. Cleithronomys grapperi was captured only in the fall; Zapus hudsonius (meadow jumping mouse) and Napeozapus insignis (woodland jumping mouse) were captured only in the summer. It was probable that the latter 2 species were inactive during early spring and fall (Burt and Grossenheider 1976).

Similarly, the small mammal community of the burned area was composed primarily of the 2 species of Peromyscus (32 of 55 individuals). Sorex cinereus comprised almost a fourth (12 of 55) of the total individuals captured. This shrew had been associated with herbaceous areas similar to the burned area (Pearson 1959).

The spruce-fir forest had a more abundant small mammal community than either of the shrub balds. Peromyscus maniculatus was by far the most abundant small mammal with 71 of 136 individuals captured. C. gapperi was next in abundance (22 of 136 individuals). Sorex femeus (smoky shrew) and Neotoma floridana (eastern woodrat) were captured only in this area.

Although controlled burning slightly lowered small mammal populations, it was important in maintaining a grassy area. Synaptomys cooperi (southern bog lemming) and Microtus pennsylvanica (meadow vole) probably reached their highest altitudinal distribution on the burned area. Sorex cinereus numbers increased in the burned area. These mammals preferred dense, herbaceous vegetation. The grassy, open areas resulting from the burn complemented the shrubby unburned

area and forested spruce-fir area.

Species diversity (H') (Shannon and Weaver 1949) and equitability (J') (Pielou 1967) were employed as measures of community diversity (see Table 2). Paired t-tests were made for seasonal and area comparisons (Snedecor and Cochran 1967). All tests were made with significance probability equal to 0.05. No seasonal comparisons were significant for the unburned area. In the burned area, fall species diversity and equitability values were lower than spring and summer values. Summer species diversity was greater than fall diversity in the spruce-fir area. There were no significant comparisons between areas.

Low number of species and unequal distribution of individuals among species resulted in low diversity values. High sample variability limited the number of significant comparisons for diversity indices. The number of species varied from 4 to 8 in seasonal comparisons. All areas were dominated by 1 or 2 species. The combination of these factors results in low diversity. Diversity values increase as species number increases and as the proportion of each species in the population approaches evenness. To control sample variability, an attempt was made to trap when weather conditions were stable. Nevertheless, the number of captures varied widely resulting in high variances.

Lower fall diversity values were possibly artifacts of different trapping methods. In fall, traps were emplaced on five 0.08 ha plots per area (30 traps/area); in spring and summer, grid trapping was instituted (144 traps/area). Low values of H' and J' evolved from a low number of captures of previously uncaptured individuals. As there were only 30 traps per acre, only a limited space and resident population were sampled. Grid trapping sampled 2.68 ha compared with 0.4 ha for plot trapping.

TABLE 2. SPECIES DIVERSITY (H') AND EQUITABILITY (J') VALUES FOR SEASONAL SMALL MAMMAL TRAPPING IN THREE HABITAT TYPES IN WESTERN NORTH CAROLINA.

AREA	SEASON			
	FALL	SPRING	SUMMER	OVERALL
Unburned shrub bald	H' 0.48±0.47*	0.71±0.47	1.08±0.51	0.71±0.51
	J' 0.60±0.50	0.74±0.42	0.87±0.19	0.71±0.40
	s=4, n=18**	s=5; n=33	s=6; n=33	s=10;n=84
Burned shrub bald	H' 0.25±0.35	0.86±0.24	0.83±0.19	0.58±0.40
	J' 0.36±0.50	0.92±0.07	0.98±0.03	0.60±0.44
	s=4; n=16	s=5; n=25	s=5; n=14	s=6; m=55
Spruce-fir forest	H' 0.55±0.49	1.04±0.44	1.03±0.19	0.82±0.46
	J' 0.59±0.49	0.88±0.16	0.78±0.10	0.72±0.36
	s=5; n=28	s=5; n=53	s=8; n=55	s=9; n=136

*mean ± one standard deviation

** s=number of species

n=number of individuals

In summary, prescribed burning had no effect on the species diversity of the small mammal community of a shrub bald. Species number did not vary much between areas. Both areas were dominated by 1 or 2 species in the same relative proportions of the population. For these reasons, diversity values were similar.

White-tailed Deer and Eastern Cottontail Populations

Fecal pellet counts were made monthly in all areas to determine relative useage of the respective areas by white-tailed deer and eastern cottontail. Counts indicated that the burned shrub bald had greater use by deer than either the unburned or spruce-fir areas. Both shrub balds were utilized more by deer in spring than summer. Rabbit pellet counts did not give conclusive results. The groups were very difficult to see in the shrub balds.

These results were similar to Vogl and Beck's (1970) study which indicated increased usuage of burned areas by deer. This increased usage was possibly linked to an increase in potential deer browse (Dills 1970, Hallisey and Wood 1976.)

Other Mammal Species

The presence of other mammal species was determined by observation and track, scat, and skull identification (see Table 3). Two species were noteworthy as they were uncommon in western North Carolina (Lowman 1975). The New England cottontail (Syvilagus transitionalis) was identified by a skull found in the spruce-fir area. This identification was confirmed by the North Carolina Museum of Natural History. Odum (1949) and Johnston (1967) had reported this species from the Highlands, North Carolina, area (50 km from study ares). However, no records were found that indicated this species had ever been found above 1700 meters elevation. A least weasel (Mustela nivalis)

was observed in the spruce-fir area. No specimen was collected; but, the animal was seen at 6 meters for about 30 seconds. As reported by Lowman (1975), there had only been 4 specimens reported from North Carolina. Barkalow (1967) collected one from nearby Henderson County.

Birds

Because of its scarcity (less than 10 breeding pairs east of the Mississippi River (Greenwalt 1978), the golden eagle was of particular interest. One immature was sighted for one day in April, 1979, in the study area. There was no indication that the area was utilized during the winter by golden eagles. The area had high recreational usage even during mild winter months. These activities may have discouraged eagle overwintering.

The balds afforded excellent conditions for recreational birdwatching. These open areas were good observation points for viewing ravens, hawks, sparrows, and warblers. A detailed account of birds of the study areas was given by Peterson (1979).

MANAGEMENT IMPLICATIONS

Each of the 3 study areas was inhabited by an unique animal community. In order to maintain these communities, efforts should be directed toward habitat management. Management includes preservation and maintenance of key habitat areas. Unburned shrub balds should be preserved when possible. Their succession to forest can be arrested by prescribed fire with a 10 to 15 year interval. Burned shrub balds require periodic control burning with a 5 to 8 year cycle (Barden 1978). Spruce-fir forests should be preserved. Planting or seeding of areas that formerly were covered by spruce and fir will help to perpetuate this habitat. Balds and spruce-fir forests should be monitored to determine the effects of management and to dictate potential management activities.

TABLE 3. MAMMAL SPECIES KNOWN TO OCCUR IN THE THREE HABITAT TYPES IN WESTERN NORTH CAROLINA.*

SPECIES	UNBURNED SHRUB BALD	BURNED SHRUB BALD	SPRUCE-FIR FOREST
Sorex cinereus	+	+	+
S. fumeus			+
Blarina brevicauda	+	+	+
Syvilagus floridanus	+	+	+
S. transitionalis			+
Tamias striatus	+		
Marmota monax	+	+	+
Tamiasciurus hudsonicus	+		+
Peromyscus maniculatus	+	+	+
P. leucopus	+	+	+
Neotoma floridana			+
Cleithronomys gapperi	+	+	+
Microtus pennsylvanicus		+	
Synaptomys cooperi	+	+	
Zapus hudsonicus	+		
Napeozapus insignis	+	+	+
Ursus americanus		+	
Mustela nivalis			+
M. frenata			+
Mephitis mephitis	+	+	+
Felis rufus	+	+	+
Odocoileus virginianus	+	+	+

*Nomenclature follows Jones, et al. (1975)

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PRESCRIBED BURNING FOR GOLDEN EAGLE HABITAT MANAGEMENT

Ben A. Sanders
Chattahoochee and Oconee National Forest
U.S. Forest Service
Gainesville, Georgia 30501

INTRODUCTION

The Appalachian balds have been an enigma to plant ecologists for decades. Discussions of their origin and maintenance have been given in more than sixty-six major scientific papers. The preponderance of theories explaining their origin involve climatic, edaphic, or pyric forces, but activities of Indians and infestations of gall wasps have also been discussed as factors.

Mark (1958) defined balds as areas of naturally occurring treeless vegetation located on well-drained sites below the climatic treeline in a predominately forested region. Natural balds are of two types: grass and heath (Mark 1958). Natural balds usually occur distinctly as one type or another. In North Carolina we have broadened the classic concept of balds to include successional beech-birch-fire cherry stands which resulted from deforestation of spruce-fir forests by logging, wildifre, or a combination of the two. Most of these successional stands occur above 1500 meters (approximately 5,000 feet) and many exceed 1800 meters (approximately 6,000 feet).

Some students of bald ecology have concluded that balds are endangered ecosystems (Bryne 1973, Gershmehl 1970). They have based this conslusion on

comparison of records of the former areal extent of selected balds, and observations of succession which can be easily seen in the field. Lindsay (1976) determined from interviews with older settlers in Great Smoky Mountains National Park that upon cessation of grazing there were striking structural and compositional changes on park balds within five years. Some of the early settlers claimed they became almost unrecognizable as balds.

ORIGIN OF A BALD

One of the largest and most interesting of the successional balds in the Balsam Mountains lies in the Pisgah Ranger District, Pisgah National Forest, north of the Blue Ridge Parkway, and is largely designated Shining Rock Wilderness Area. The land uses and catastrophic forces which changed the dense spruce-fir forest which previously existed into what it is today—a mosaic of grass balds, heath balds, and stands of fire cherry, yellow birch, and beech—have been present on a smaller scale throughout most of the spruce-fir zone of the southern Appalachians.

In 1900, the slopes of the Black Balsams were densely covered in red spruce except for the highest peaks where Fraser fir predominated. Around 1910 the timber was sold to feed the newly build pulp mill at Canton, North Carolina, and a network of railroads was laid down to haul out the logs. Virtually all of the roads into the area today follow the old railroad grades.

The timber sale contract contained a provision allowing the loggers to burn the logging debris in order to reduce the amount of highly flammable material present on the ground. In 1926, a wildfire broke out which swept over many hundreds of acres.

By 1942 all logging had been completed and the area had grown up in blueberries and grass. On the opening day of trout season that year, a fisherman fell into Shining Creek, and since the weather was still very cool, he built a fire to dry his clothes and to get warm. Evidently this fire was left smoldering, and by the next day smoke was detected by the tower on Frying Pan Gap.

Since this was wartime, few Forest Service men were available to fight the fire, and crews composed of local men were rounded up and hiked into the blaze. According to one of the firefighters, Nobreeches Ridge got its name because by the time they reached the bottom, the firemen's britches had been torn away by the brush and briars.

The fire was assisted by arsonists who set 14 additional fires on the west side. By the time all of these fires had burned together, and the fire was under control, almost two weeks had elapsed. Virtually the entire area had burned over once again. The process of plant succession led to the development of a new landscape and a new community totally unlike the spruce-fir forest of the past. The results were of enormous importance to both man and wildlife.

One has only to walk into the spruce-fir forest at Devils Courthouse to appreciate what Shining Rock was like before the deforestation and fires. Because of the dense shade beneath the trees, almost all of the photosynthesis takes place in the tree tops. Ground vegetation is sparse and consists of a few species able to grow in shade. The Shining Rock areas provide a striking contrast with their lush ground cover of forbs and grasses on the grass blads, and the shrub balds of blueberry, rhododendrons, azalea, and blackberry.

BALD MANAGEMENT

Many wildlife habitat changes occurred after the deforestation and fire. The red squirrel, winter wren, and New England cottontail of the spruce-fir found the habitats of the Shining Rock area inhospitable. Other animals found the balds more to their liking, however, and juncos, song sparrows, cottontails, and woodchucks proliferated. The openness, high density of small mammals, and probably the large size of the area has drawn a wintering population of golden eagles. During the course of a Forest Service study conducted during the winter of 1974-75, golden eagles were seen in the Shining Rock area on 12 occasions by one observer, and raven sightings were about five times more frequent than in adjacent forested areas. According to Dr. Walter Spofford (1970), the golden eagle cannot exist in forested terrain except where there are sufficient openings which supply high prey densities and open hunting territory.

As a result of the golden eagle hunting, the Forest Service began bald management in 1973 on Black Balsam Mountain following a thorough public review. Approximately 42 hectares (105 acres) were included in this initial burn. It was assumed that fire would topkill the woody regetation which would later sprout and be controlled by deer, woodchucks, and rabbits. The overall objective was to maintain high densities of small mammals.

The strategy for burning was to build a control line along the crest of the mountain with fire and water. After this line was judged fireproof, strip head fire lines were set along the side of the mountain.

Fire weather factors during the burn were as follows:

Days since rain - 4

Class Fire Day - low 4

Buildup Index - 10

Spread Index - 24

Wind - S/SW 8-15 mph

Relative humidity - 45-52 percent

Temperature - 85 degrees (mean)

The initial Black Balsam burn was not judged by anyone as completely successful in meeting the objectives. W.D. Zeedyk (personal communication) estimated only 30-40 percent effectiveness due to compacted fuels and variable weather conditions encountered during the burn. Jim Byrnes (personal communication) stated that the mountain laruel was effectively reduced, but noted that it was already stressed before the burn. He recorded that rhododendron and blueberry suffered much lower mortality.

Tennent Mountain was burned the following November in order to compare the results of fall burning in similar vegetation. Based on Jim Byrnes' recommendation a portion of the Black Balsam burn area was included, presumably to test the results of double burning. This burn was ignited on November 7, and it rekindled on November 8. Because of the overall poor performance it was reignited on November 12.

In conjunction with the Tennent Mountain burn, a study of local weather conditions was conducted between August 28, and November 16, 1973. By observing the behavior of the fire during the three days in response to various meteorlogical phenomena, certain correlations were seen. Among the more important were the following (Baker 1973):

1. Buildup and cloud cover were the most important factors affecting fire behavior.
2. Higher fire danger days than are normally considered suitable must be used when burning heath balds.

Ten burns totaling 495 hectares (1223 acres) have been conducted since May 1, 1973. Eight have been spring burns in April or May, and two have been fall burns in November. Two have been in view of the Blue Ridge Parkway.

CONCLUSIONS

Based on our burning experiences in bald habitat, we have reached several conclusions:

1. Spring burning is more desirable than fall burning due to rapid greenup; less possibility of nutrient leakage, and smaller esthetic impact.

2. Water lines are entirely satisfactory, thus eliminating the need to scar the land with fire plows.

3. Burning success is correlated more with aspect than percent slope. Favorable aspects are southeast to west.

4. Burning intensity seems to be positively correlated with the abundance of blackberry canes as fuel.

5. Topkill of woody vegetation is intensified in the presence of relective boulders or burning logs.

6. Sprouting of topkilled vegetation may occur as late as 18 months following a burn.

7. Deer, woodchucks, and rabbits relish burn-induced sproutgrowth, and may be important in maintaining bald ecosystems.

8. Fire-induced erosion has been minimal because very little mineral soil has been exposed as a result of prescribed burns.

9. Costs may range between $8 and $20 per acre, depending on the size of the burn.

In terms of habitat management for golden eagles and ravens, we view burning of balds as our primary tool to increase prey densities and maintain open habitat for hunting. Even more important is the need to maintain large

sized habitats such as the 89 square kilometer (22,000-acre) Shining Rock area for golden eagle management. The frequency of sightings in this area suggests that large habitats may be necessary to support these raptors.

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GRASSY BALDS MANAGEMENT IN PARKS AND NATURE PRESERVES: ISSUES AND PROBLEMS

Susan P. Bratton and Peter S. White
Uplands Field Research Laboratory
Great Smoky Mountains National Park
Gatlinburg, Tennessee 37738

INTRODUCTION

When conservationists first proposed a national park for the Great Smoky Mountains, the beauty of the natural landscape and the diversity of vegetation were both primary considerations. Proponents of the park idea took early visitors and people of political importance to visit several types of sites with interesting botanical resources of great aesthetic appeal. Favorite goals for "sales trips," included virgin cove hardwoods forests, Mount LeConte, and one or more of the grassy balds in the proposed park area. Balds such as Gregory and Andrews are mentioned frequently in post 1900's accounts of the Smokies and have been favored hiking destinations for decades (Campbell 1960).

Preservation of the grassy balds and their flora was an early issue in park management for Great Smoky Mountains National Park (GSMNP) and has since become important for the Appalachian National Scenic Trail, the Blue Ridge Parkway, and several southern Appalachian National Forests. Some of the lands concerned are considered to be preservation rather than conservation areas, or are now (or may in the future be) under wilderness legislation. The purpose of this paper is to briefly discuss some of the major considerations in managing grassy balds and other high elevation treeless communities within parks or nature preserves.

DISTURBANCE ECOLOGY OF THE BALDS

High elevation openings in the Southern Appalachians include a variety of communities, almost all of which are disturbance related. In the GSMNP these openings may be categorized as landslides, burn scars, grassy balds and fields, roadsides, shelter clearings, heath balds, and cliff faces. Only the latter two of these usually do not have recent disturbance histories. If one includes the whole mountain chain there are a number of additional shrub or grass dominated communities, some of which may be related to a definite disturbance, a logging fire for example, and others of which may be related to extreme climatic conditions or edaphic factors.

In GSMNP, grassy balds have been the principal target of most research projects and management plans. The history of most of these openings can be fairly well documented, at least for the last century. A majority of burn scars which are still open resulted from fires in logging slash during dry years in the 1920's (Lambert 1958). All the areas called grassy balds or fields by the settlers have a history of grazing, primarily by sheep and cattle. Informants and historic photographs indicate that the "fields," such as Spence Field and Russell Field were cut out of hardwood forest sometime after the Civil War. No direct evidence for burning of the open bald surfaces has been found, but the settlers did burn the surrounding forests. The possibility exists that fire and/or cuttimg may have been used to clear some of the balds prior to the Civil War (Lindsay 1976, Lindsay and Bratton 1979a).

The origin of the balds is much debated. Among proposed natural causes for balds are fire (Clements 1936), gall wasps (Gates 1941), ice and frost damage (Harshberger 1903), windthrow (Brown 1941), and change in climate (Camp 1931, Whittaker 1956, Mark 1958, Billings and Mark 1957). The most commonly

proposed anthropogenic causes for the balds are clearing by the Cherokee Indians (Wells 1936, 1937, 1946, 1956) and clearing by white settlers, mainly through the use of fire (Gersmehl 1970).

Whatever the origin, several points are important to management: First, despite all the arguments and literature, the scientific community is still not in agreement on the issues, and the case has not yet been closed for older sites like Gregory Bald (first record ca. 1833). Second, there does not appear to be any active "natural" creation of grassy balds occurring in GSMNP at the present time. GSMNP has had thorough fire suppression since the 1930's, so if lightning fire were an important source of balds, this factor has been greatly reduced in impact. However, no action has been taken that would eliminate gall wasps, ice damage, windthrow or climatic variables. Post-park grassy openings include roads, shelter clearings, and landslides. Third, the windthrows and burned areas these authors have observed were quickly occupied by shrubs and tree seedlings. Burn scars are not very similar to grassy balds and allowing an occassional large fire would probably not maintain the grassy bald as a community type (Lindsay and Bratton 1979b). Fourth, although the origin of grassy balds may have been natural, their present flora is partially an artifact of anthropogenic interference. Grassy balds, at least as they existed 1900-1940, are better considered an historic than a dynamic element of the vegetation of GSMNP.

A final important managerial point is that as soon as grazing was terminated on grassy balds, plant succession began. Without sheep, cattle, and associated impacts of herders, woody plants began to invade the open grass sward. Although succession has been surprisingly slow, at least when compared to succession after logging, (Bruhn 1964, Lindsay and Bratton 1980), probably all the balds in GSMNP will be closed forest within 30 to 70 years.

If one is interested in managing balds as open areas, the various phases of succession can become either targets for maintenance or targets for removal. The exact woody species composition and successional rate varies with bald location, topographic situation (e.g. elevation), and the surrounding forest type (Lindsay and Bratton 1980). Several general states can be recognized, however:

a) Pregrazing phase. If this state ever existed, it may have a flora similar to burn scars.

b) Grazing phase. The balds were almost entirely free of shrubs, the centers dominated by a mountain oat grass (Danthonia compressa) sward. The grass was very short with some soil erosion evident. The areas surrounding the balds were largely clear of shrubs and tree seedlings due to a browse line. There may have been stumps near the edges. The balds were probably expanding due to grazing impacts.

c) Release stage. When the cattle and sheep were removed, the grass grew to knee height. Herbs and shrubs begin to invade from the surrounding forest. Bald boundaries with the forest remained about the same for the first few years.

d) Shrub invasion stage. Shrubs begin to ring the edge of the bald and establish patches on the balds surface. Shrub flowering displays are usually best at this time.

e) Tree invasion phase. Trees begin to overtop and obscure the shrubs. The edges of the bald shrink in towards the center.

f) Closure. Trees and shrubs grow over the grasses and herbs. The flora of the bald approaches that of the surrounding forest. Flowering displays continue to decline.

The first two phases of this series are disturbance phases and, under present conditions, appear to require human interference to maintain them. The next three phases are recovery phases and some type of continuing disturbance or continuing pulses of disturbance are necessary to hold the flora in these states. It may, in fact, be impossible to hold the flora at an intermediate successional phase without pushing it back to an earlier state and then releasing it. The last phase is probably the normal steady state phase for Appalachian ridge tops and no active management differing from that for surrounding forests is necessary.

TO MANAGE OR NOT TO MANAGE

The first issue in the management of grassy balds is whether to take any action at all. A number of the balds are in proposed wilderness or inaccessible locations. If the balds are anthropogenic, should one interfere with natural recovery via plant succession? This issue is more philosophical than biological and, with other decision-making problems, is outlined in Table 1.

In the course of management planning for GSMNP, exclusion of one or two representative balds from proposed wilderness areas has been suggested as a possible soultion to the restrictions imposed by wilderness legislation. Historic zones could encompass Gregory Bald, Andrews Bald, and small sections of the surrounding forests. The detraction of these 'holes' from the value of the wilderness is difficult to quantify, however. In the end, public opinion will probably determine the direction selected.

TABLE 1. ISSUES IN GRASSY BALDS MANAGEMENT.

I. Philosophical Decisions

1) The importance of naturalness. Should balds be maintained if they are anthropogenic?

2) The importance of wilderness. Should balds be excluded from legislated wilderness? If balds are not excluded, should they be managed and what techniques are appropriate?

3) The importance of history. Should balds be considered as historic vegetation types? Should management be as historically accurate as possible? What techniques are appropriate from an historic point of view?

4) The importance of rare species? Should balds be managed partially for individual rare species? Is the presence of rare or endangered plant or animal species a justification for management when it might not otherwise be done, as in the case of some wilderness areas?

5) The importance of community composition. Do balds represent unique plant communities which are worth preserving for their own sake? Is some specific successional phase the most desirable for management?

II. Biological Decisions

1) Orientation to individual species. How important are the individual species to management? Is it acceptable to manage some species one way and some another? What sorts of information and management are necessary for rare species?

2) Orientation to community composition. Which elements of which parts of the communities involved should be maintained? How drastic should disturbances be? Is the grass sward going to be the critical element. Should we manage for diversity of community types?

3) Orientation to shrub distribution. Will any flowering shrubs be left where they did not occur historically? Will some mixture of shrubs and grasses be the goal of management, if it is undertaken, or will shrubs be limited to the surrounding forest?

4) Orientation to the edge zone. Will the edge of the bald be in its historic position? Will any management take place in the forest around the bald?

TABLE 1. ISSUES IN GRASSY BALDS MANAGEMENT. - CONTINUED

5) Orientation to impacts on the environment. What possible impacts of management are unacceptable? Can all impacts on areas outside of designated managerial zones be avoided?

III. Programming Decisions

1) Economic considerations. How much will management cost and is it feasible? Is management of balds of high enough priority to delegate the funds? What is the cheapest acceptable method of management. Can volunteer help be used?

2) Organizational considerations. How is balds management related to other on-going resources programs? How is it related to fire management? Visitor management and use of the sites? Wildlife management? Agricultural management?

3) Public relations considerations. How can the public be best informed of managerial decisions and actions? Does the public agree with the goals and substance of the program?

4) Planning considerations. How long will it take to complete different phases of the managerial program? How often will managerial action have to be initiated?

5) Regional considerations. How does the management program for a specific site relate to what others are doing? How does the overall program for a managerial unit such as a park relate to what others are doing?

A related issue is what to do about disturbance-dependent rare plant species if balds are not managed. Protection of endangered plants might be enough of a rationale, even in wilderness, to keep at least a small area of a bald open. But then, should one just manage a few openings and lose the historic outline of the bald?

Another major philosophical issue is history. The balds were important to the founders of parks such as GSMNP, and were part of a long cultural. tradition. Hikers, campers, and walkers have visited the balds and recorded their scenic values for more than a century. If the balds were buildings, they would almost certainly be protected, just because of their age and their importance in local literature.

WHAT TO MANAGE

After deciding to manage, the planner has to ask: What do I want the bald to look like? Some specific historic state? What else has to be considered?

In some cases, the role of individual species may be important and these may have become established at different points in the bald's history and under different conditions. Table 2 shows a list of rare high elevation vascular plant species from GSMNP. Note that those found on balds are also found in other habitats and are not all similar in their natural history. Managing for several of these species, as one might have to do on Gregory Bald, requires individual maps and plans for each population. Rare and endangered species needs may, in fact, be in conflict with managing for one specific historic state.

A question related to species vs community management, is what to do about flowering shrubs that are part of the succession over the grass sward, but provide showy flowering displays, or, as in the case of the azaleas on Gregory Bald, represent a unique biological resource. Is it acceptable to spare the

TABLE 2. LIST OF RARE HIGH ELEVATION, OPEN HABITAT, VASCULAR PLANT SPECIES FROM GREAT SMOKY MOUNTAINS NATIONAL PARK. SOME OF THE LISTED SPECIES ALSO OCCUR IN CLOSED FORESTS. ABBREVIATIONS ARE AT THE END OF THE TABLE.

SPECIES	LISTED STATUS	PRESENT ON GRASSY BALDS (incl. fields)	HEATH BALDS	CLIFFS	LAND-SLIDE SCARS	BURN SCAR	SEEPS	INVASIVE	FLORISTIC AFFINITY
Agrostis borealis var. americana	NC-PER-E TN-SC			X					A
Bromus ciliatus	TN-SC					X			N
Cacalia rugelis	N2-T N3-1 NC-PC-E, END TN-E	X	X	X	X	X			E
Calamagrostis cainii	N2-T N3-1 TN-E			X	X		X	X	E
Carex cristatella	NC-PER-E					X			N
Carex misera	N-T N3-3C NC-PC-E, END TN-T	X		X	X	X	X		E
Carex projecta	NC-PER-E					X			N
Carex ruthii	TN-T	X			X		X		E
Elymus riparins	NC-PER-T					X			N
Gentiana lineraris	TN-T			X	X		X		ND
Geum radiatum	N-E, PRM-E N3-1, NC-PC, E, END TN-E	X		X					E

TABLE 2. CONTINUED

SPECIES	LISTED STATUS	PRESENT ON GRASSY BALDS (incl. fields)	HEATH BALDS	CLIFFS	LAND-SLIDE SCARS	BURN SCAR	SEEPS	INVASIVE	FLORISTIC AFFINITY
Glyceria nubigena	N-E, PRM-E N3-1, NC-PC, E, END TN-E	X			X		X	X	E
Habenaria psychodes	TN-T	X					X		N
Helianthemum bicknellii	NC-PER-E TN-SC	X							N
Hypericum graveolens	TN-T	X		X	X	X	X	X	E
Hypericum mitchellianum	TN-T	X					X	X	E
Juncus trifidus var. monanthos	N3-1 NC-PE-E, DISJ			X					E
Lilium grayi	N-T, N3-2 NC-PC,T,THRU, EXPL TN-E, EXPL	?							E
Lycopodium selago	NC-PER-T TN-T			X					A
Menziesia pilosa	TN-SC	X	X	X	X	X			E
Parnassia asarifolia	NC-PER-T			X	X		X		N

TABLE 2. CONTINUED

SPECIES	LISTED STATUS	PRESENT ON GRASSY BALDS (incl. fields)	HEATH BALDS	CLIFFS	LAND-SLIDE SCARS	BURN SCAR	SEEPS	INVASIVE	FLORISTIC AFFINITY
Pieris floribunda	NC-PER-T TN-T		X						E
Polygonum cilinode	TN-PE	X							N
Prenanthes roanensis	N-T,N3-2, NC-PC-T,THRU	X				X		X	E
Pycnanthemum montanum	TN-T	X							E
Rhododendron bakeri	N-T,N3-3C NC-PC,T,THRU, EXPL TN-DROPPED	X							E
Rubus idaeus var. *canadensis*	NC-PER-T			X			X		N
Scirpus cespitosus var. *callosus*	NC-PER-T			X	X				A
Stachys clingmanii	TN-T	X				X	X	X	E

ABBREVIATIONS FOR TABLE 2.

N - 1975 Smithsonian List - National

PRM - Published in Federal Register "Proposed Rule Making"

N2 - Ayensu and DeFilipps 1978, National List

N3 - Draft National List, 1980

1 - Category one -- candidate species

2 - Category two -- species which need more study

3 - Category three -- deleted species

3C -- more abundant or widespread than previously thought

NC - North Carolina List

TN - Tennessee List

PE - Possibly extirpated

E - Endangered

T - Threatened

SC - Special

PC - Primary Concern

PER - Peripheral species at its edge of range

END - Endemic

DISJ - Disjunct

EXPL - Exploited

THRU - Throughout its range

Floristic affinity

A - Arctic-alpine

E - Endemic, Southern Appalachians

N - Northern species near southern range limit

ND - Northern species significantly disjunct from nearest locales.

'interesting' and 'pretty' while cutting the other woody species? The policy on this is related to the final location of the edge of the bald. If the historic position is desired it would be necessary to slowly remove the shrubs, encouraging the species to return to the edge of the bald by partially opening the forest canopy.

In his or her mind's eye, the manager has to see each area of the bald, the open center, the edge, the surrounding forest, and conceptualize what changes are necessary and what impacts are undesirable. Managing only for the center may lead to an odd looking edge and vice versa.

HOW TO MANAGE

If an organization or individual decides to manage a particular bald, how should it be done? The National Park Service and other agencies have tested several techniques which are reviewed in Lindsay and Bratton (1979a). The relative advantages and disadvantages of some of these methods are shown in Table 3. Each of these methods can be used by itself, or they can be used in combination.

Grazing, for instance, is the most historically correct method for an open grass sward and will suppress shrubs if stock densities are high enough. Grazing is expensive, however, and may have undesirable impacts on rare plant species.

Fire, by contrast, is cheaper but may not suppress all the shrubs. Mowing is non-historic in most areas but offers optimum control for selective plant removal. Herbicides are inexpensive but may be objectional if improperly applied or if used in a national area.

TABLE 3. PROBABLE EFFECTS OF SOME POTENTIAL MANAGEMENT TECHNIQUES FOR GRASSY BALDS IN GREAT SMOKY MOUNTAINS NATIONAL PARK (LINDSAY AND BRATTON 1979a).

MANAGEMENT OPTION	HISTORIC AUTHENTICITY	RARE PLANT MANAGEMENT	WILDLIFE MANAGEMENT	COMMUNITY COMPOSITION
Grazing	Cattle, sheep, mules all historic	Difficult to control without exclosures	Removes cover for small mammals, may attract predators	Closest possible to pre-park, should result in a grass sward
Fire	Possibly used historically for opening, not maintenance	May encourage some species	Excellent	May encourage non-historic species, blueberries may be stimulated instead of grasses
Cutting	Certainly used historically around bald edges	Close selection for individual species	Good	May result in root sprouting, must be used with some other technique
Mowing	Not historic at most sites	Close selection for individual species	Good	Best imitator of grazing
Herbicide	Not historic	Difficult to control if broadcast, may be selectively used on stumps	Toxicity problems possible	May eliminate sensitive elements if broadcast, can control root and stump sprouts

TABLE 3. CONTINUED

MANAGEMENT OPTION	ENVIRONMENTAL IMPACTS	POSSIBLE NEGATIVE PUBLIC REACTION	ECONOMICS	OTHER
Grazing	Possible water contamination	May be in wilderness	Expensive unless on lease, requires herder in backcountry	May require fence, other aesthetic impairments
Fire	Flush of nutrients, fire may escape	May be negative if extensive blackened areas or smoke	Inexpensive when properly used	Time of year is important, results may be uneven across bald's surface
Cutting	Slash disposal	Negative reaction to stumps, slash, extensive trampling	Moderate expense, unless done by volunteers	Needs other treatment
Mowing	Slight	Negative reaction to tool use in natural area	Moderate expense, unless done by volunteers	Must be repeated once or twice annually, power equipment not feasible in most areas
Herbicide	Possible contamination of water and soils	Negative reaction to chemicals in natural or camping areas	Inexpensive	Use may be limited in Biosphere Reserve

Sites that are almost closed into forest may have to be cut, and slash removed. This is expensive but can, as we found in GSMNP, be done with Youth Conservation Corps or even volunteer crews.

Most areas would probably require a regime that mixed methods and changed through time. Cutting followed by a slash burning and removal of sprouts, might eventually convert into mowing and cutting, then mowing only, as trees and shrubs were suppressed.

A competent director or crew leader who is sensitive to botany, ecology, and aesthetics is critical to the success of any management program. It is also important that funding continue for a long enough time period. If trees were cut, for instance, and a program terminated before sprouts were removed, the result would be brushy regrowth that represents neither the historic nor the natural successional state.

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DISCUSSION GROUPS

The approximately 54 participants (see Appendix B) were placed into five representative discussion groups which met twice during the workshop (see Appendix A) to address the issues of Southern Appalachian bald management from the perspectives of (1) short-term and long-term research needs, (2) effects of the agencies' management policies and regulations, and (3) public education and public involvement from the status quo of little or no management to a state of intensive management and ecosystem manipulation. Each discussion group consisted of scientists, managers, and the public. Near the conclusion of the workshop the leaders from each group presented the consensus of the ideas of each group to all workshop participants. These ideas were recorded and categorized on flip charts as they were presented by Dean John McCrone, Executive Director of SARRMC. On the basis of the ensuing discussion several conclusions were reached and recommendations suggested. The suggested agenda for action follows the conclusions from the three discussion topics. Below is a list of the group leaders/recorders, followed by a summary of this workshop discussion, and a summary of the major recommendations.

Group 1 Robert Currie

Group 2 George S. Ramseur

Group 3 Susan Bratton/Judy Murray

Group 4 Rima Farmer

Group 5 Paul R. Saunders

Short Term and Long Term Research Needs

1. Develop a uniform definition of Southern Appalachian balds from Virginia and West Virginia to Georgia; such as herb-grass, heath-shrub, elevation of 4500 feet or more, an acre or more in extent, etc.

2. Recognize and research the probable different origins of these balds in an attempt to answer the question of bald origin.

3. Develop a system that will inventory and classify the remaining bald resource as soon as possible, especially where succession to a forest canopy is quite rapid.

4. Monitor the successional rates of the different types of balds using aerial photographs, historical records, interviews, and field studies.

5. Update the lists of biota associated with these balds to ensure that valuable biotic resources such as threatened and endangered species are not lost.

6. Systematically examine promising blads for evidence of human origin of some balds, patterns of human use, and associated, significant archeological findings. Efforts should be made to date important finds.

7. Where possible conduct pollen analysis on or near balds to describe past vegetational and climatic changes.

8. Examine the edaphic factors of balds as they relate to bald origin, bald succession, and the biotic communities found on these balds.

9. Develop a coordinated center or data base for existing and new research data in order to prevent additional cost and needless duplication, to facilitate agency and research communication, and to record results of implemented management procedures for controlling bald succession.

10. Determine past and current levels of visitor use on balds to develop future recreation use trends and management strategies to control use if it becomes too great.

11. Determine the impact of this recreation use on the bald resource both now and in the future.

12. Bald maintenance and expansion research should experimentally consider such alternatives as grazing, fire, mechanical site clearing and modification, herbicides, and a combination of these alternatives. Use of natural grazing species such as elk, bison, and deer should be thoroughly explored, as well as the use of domestic grazers. Herbicides which kill sprouts and decompose rapidly should be identified.

13. All bald related research whether basic or management in purpose should utilize permanent plots of similar configuration and collect similar types of data so that results are comparable.

Management Needs

1. Study and summarize the management options available to the primary private, state, and federal agencies which own balds with respect to maintaining the open bald environments.

   A. What is the National Park Service policy on preserving or maintaining balds, reestablishing or enlarging historic balds, use of historic techniques in bald maintenance (fire,grazing, etc.), establishment of the historical period desired (see Bratton and White in these proceedings).

   B. What is the U.S. Forest Service policy on bald management, bald management in wilderness areas, addressing bald conservation under the 1974 Resources Planning Act, issues and concerns of the National Forests, and regional land use planning.

   C. What is the role of private land owners in bald management, and how can research and management results be successfully transferred to these individuals.

2. Who will develop and who will implement a bald management policy, and where will that policy be implemented. This policy must address such issues as maintaining existing balds; letting existing balds succeed to forest; expanding the borders of existing, and shrinking balds; creating grass balds from the existing shrub balds; creating new balds where none were known to exist; and the techniques that will be used to alter the balds which are selected for management.

3. Develop bald management demonstration areas which show the public how balds could be managed, increase public awareness and knowledge, and test management techniques.

4. Address use and management issues of such popular areas as Round Bald (Roan Mountain), and Gregory Bald and Andrews Bald (Great Smoky Mountains).

5. Study the effects of managing certain balds for migrating golden eagle habitats.

6. Consider the influence of the exotic balsam woolly aphid on Fraser fir populations and bald succession.

7. Study the effects of using selected balds to grow Christmas trees (Abies fraseri, Fraser fir) and their relationship to the spread of the balsam woolly aphid.

8. What should be the role of the Southern Appalachian Research/Resource Management Cooperative in the management of Southern Appalachian Mountain Balds.

Public Involvement

1. Provide the public with information on the value and use of the balds in order to direct their attention to this management issue.

2. Seek public assistance for the identification of habitats of threatened and endangered species, and the identification of unique natural areas associated with the balds.

3. The values of the balds should be identified by the public so that possible sources of user-user conflicts, manager-user conflicts, and research-user conflicts can be identified.

4. Educate the public through interpretation to the value of the balds, the various means of managing the balds, their historical use, and their possible natural and/or anthropic origins.

5. Develop groups of volunteers who can help educate the public, maintain trails on the balds, and possibly assist in the management or cleaning of the balds.

6. Seek public involvement to lessen the damaging effects of off-road vehicle use on these rather fragile biotic communities.

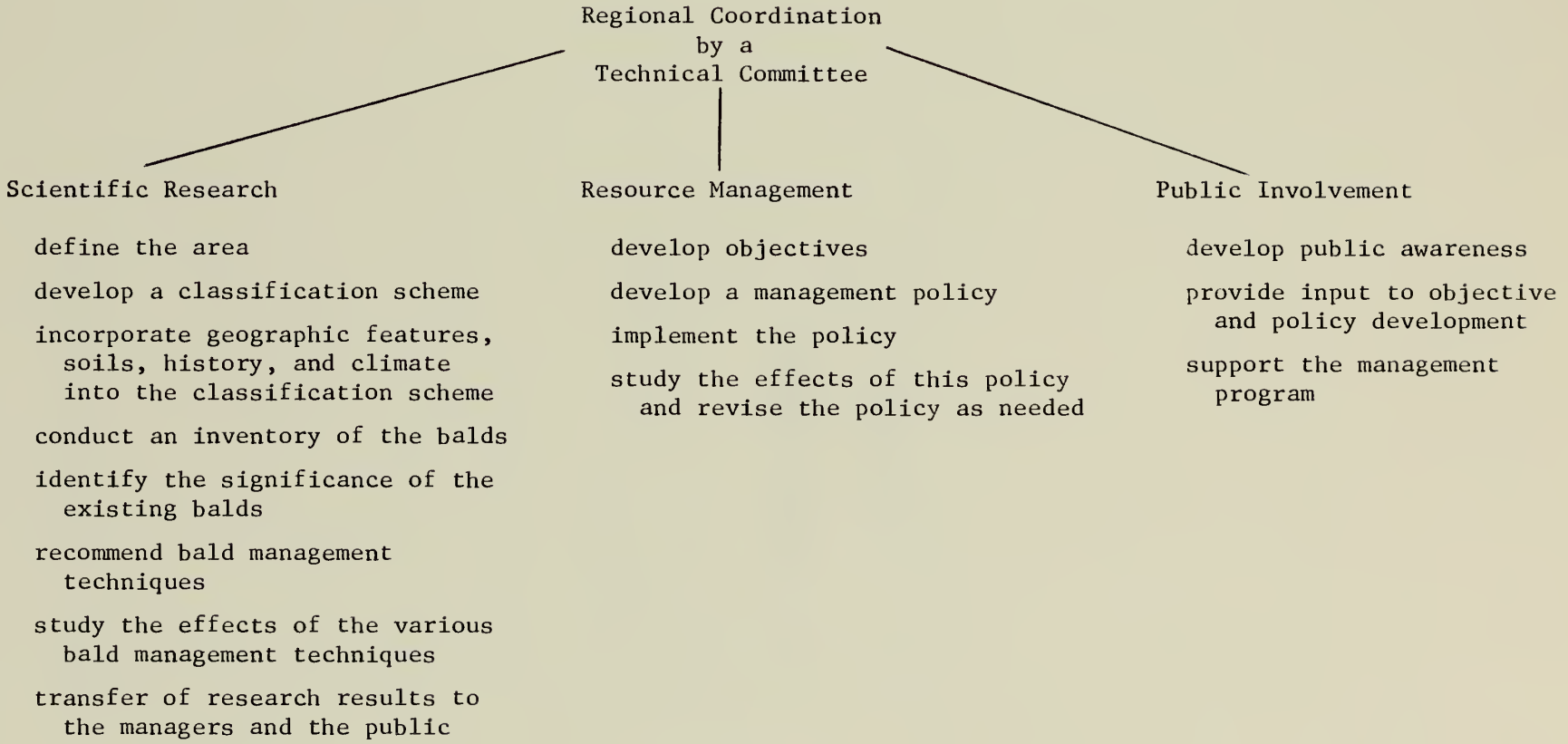
A Suggested Agenda For Action

1. The remaining bald resources must be identified, research on bald management must be conducted, and an informed public must become involved in this complex resource management issue.

2. Workshops of a similar nature which focus on current research, results of attempted management techniques, and identification and classification of balds should be held in the future. The workshops may be sponsored by SARRMC or held in conjunction with related meetings such as those of the Appalachian Trail Conference.

3. A technical committee composed of managers, scientists, and the public should be formed to see that the recommended steps are initiated, and that researchers and managers are aware of the work of each other. Nominations for this committee will be solicited from those present at the workshop.

Figure 2. A possible scenario for the management of the Southern Appalachian Mountain Balds.



APPENDIX A

Workshop Agenda

Workshop Agenda

Wednesday, November 5, 1980

3:00 to 6:00 P.M.	Arrive and get settled
6:00 P.M.	Dinner
8:00 P.M.	Welcome
	Panel Discussion of Origin, Status, Dynamics of Bald Areas

Thursday, November 6

7:00 A.M. to 8:00 A.M.	Breakfast
8:00 A.M.	Panel Discussion on Values and Public Awareness
10:00 A.M. to 12:00 Noon	Group Discussion Sessions
12:00 to 1:00 P.M.	Lunch
1:00 P.M.	Panel Discussion on Management Alternatives, Implications, and Processes
3:00 to 5:00 P.M.	Group Discussion Sessions
5:00 to 6:00 P.M.	Informal Discussion
6:00 P.M.	Steak Dinner
	Slide Show

Friday, November 7

7:00 A.M. to 8:00 A.M.	Breakfast
8:00 A.M.	Summaries by Discussion Leaders
	General Discussion
12:00 Noon	Lunch
	Check out

APPENDIX B

Alphabetical Listing of Workshop Participants

Alphabetical Listing of Participants

1. Douglas A. Blaze
   Appalachian Trail Project Office
   P.O. Box 236
   Harpers Ferry, WV 25425

2. Dr. Susan Bratton
   National Park Service
   Uplands Field Research Lab
   Rt. 2 Twin Creeks Area
   Gatlinburg, TN 37738

3. Joe Bonnette
   U.S. Dept. of Agriculture
   U.S. Forest Service
   Burnesville, NC 28714

4. I.W. Carpenter
   Biology Department
   Appalachian State University
   Boone, NC 28607

5. Alan Colwell
   U.S. Forest Service
   Pisgah Ranger District
   Pisgah National Forest
   Brevard, NC 28712

6. George S. Crockett
   U.S. Forest Service
   Wayah Ranger District
   Rt. 10, Box 210
   Franklin, NC 28734

7. R.R. Currie
   U.S. Fish and Wildlife Service
   Room 279 Federal Building
   Asheville NC 28801

8. Joseph Davis
   N.C. Nature Conservancy
   P.O. Box 805
   Chapel Hill, NC 27514

9. Michael Dawson
   Appalachian Trail
   P.O. Box 124
   Newport, VA 24128

10. C. Kenneth Dodd
    Office of Endangered Species
    U.S. Fish & Wildlife Service
    Washington, DC 20240

11. Gary Everhardt, Superintendent
    Blue Ridge Parkway
    700 Northwestern Bank Bldg.
    Asheville, NC 28801

12. Rima Farmer
    Appalachian Trail Project Office
    Box 118
    Norris, TN 37828

13. David Felmet
    P.O. Box 600
    Waynesville, NC 28786

14. Larry Freeman
    Blue Ridge Parkway
    700 Northwestern Bank Bldg.
    Asheville, NC 28801

15. Thomas A. Gatti
    Southern Appalac. Highlands Cons.
    Rt. 8, Box 434
    Kingsport, KY 37664

16. John German
    US Forest Service
    Nantahala National Forest
    Robbinsville, NC 28771

17. Ruby Harbison
    Western Piedmont Comm. College
    Morganton, NC 28655

18. Tom Hatley
    N.C. Nature Conservancy
    P.O. Box 805
    Chapel Hill, NC 27514

19. Fred Huber
    School of Arts and Sciences
    Western Carolina University
    Cullowhee, NC 28723

20. Nat Kuykendall
    National Park Service
    Denver Service Center
    Denver, CO 80225

21. Russell Lesks
    National Park Service
    Great Smoky Mts. National Park
    Gatlinburg, TN 37738

22. Dr. John D. McCrone, Dean
School of Arts and Sciences
Western Carolina University
Cullowhee, NC 28723

23. Don McLeod
Biology Department
Mars Hill College
Mars Hill, NC 28754

24. Dan Manning
U.S. Forest Service
National Forests in NC
Box 2750
Asheville, NC 29902

25. Sharon W. Morgan
Missouri Dept. of Conservation
P.O. Box 180
Jefferson City, MO 65102

26. Nora Murdock
U.S. Fish & Wildlife Service
50 S. French Broad Avenue
Asheville, NC 28801

27. Judy Murray
Southern Appal. Highlands Cons.
Box 3365
Kingsport, Ky 37664

28. Douglas Olge
Va. Highlands Comm. College
P.O. Box 828
Abingdon, VA 24210

29. John Palmer, Director
Haywood Horticultural Gardens
& Forestry Department
Haywood Technical Institute
Clyde, NC 28721

30. Levester Pendergrass
U.S. Forest Service
Suite 901
1720 Peachtree Street, NW
Atlanta, GA 30309

31. Dr. Dan Pittillo
Department of Biology
Western Carolina University
Cullowhee, NC 28723

32. Briscoe Price
U.S. Forest Service
Highlands Area Ranger
Highlands, NC 28741

33. Robert Proudman
National Park Service
Appalachian Trail
Harpers Ferry, WV 25425

34. Dr. Al Radford
Department of Botany
Coker Hall 010A
University of North Carolina
Chapel Hill, NC 27514

35. Dr. George S. Ramseur
Department of Biology
University of the South
Sewanee, TN 3737

36. Jim Roberts
U.S. Forest Service
Cheoah District
Robbinsville, NC 28771

37. Thomas D. Robinson
Scott Paper Products
Rt. 1, Box 328B
Citronelle, AL 36522

38. Charles Roe
NC Dept. of Natural Resources
& Community Development
P.O. Box 27687
Raleigh, NC 27611

39. Ben Sanders
U.S. Forest Service
P.O. Box 1437
Chattahoochee & Oconee
National Forests
Gainesville, GA 30301

40. Dr. Paul R. Saunders
College of Forest and
Recreation Resources
Clemson University
Clemson, SC 27631

41. Robert L. Scheer
Deputy Station Director
Southeastern Forest Exp. Sta.
P.O. Box 2570
Asheville, NC 28802

42. Ed Schell
Tennessee Native Plant Society
2514 Brown Mill Road
Johnson City, TN 27601

43. Dr. Garrett Smathers
National Park Service
Western Carolina University
Cullowhee, NC 28723

44. Alan Smith
Biology Department
Mars Hill College
Mars Hill, NC 28754

45. E. Laverne Smith
Office of Endangered Species
U.S. Fish & Wildlife Service
Washington, DC 20240

46. Dr. Paul Somers
Tennessee Dept. of Conservation
Div. of Planning & Development
2611 West End Avenue
Nashville, TN 37203

47. Irene Storks
Office of ENdangered Species
U.S. Fish & Wildlife Service
Washington, DC 20240

48. Joe Sullivan
Erskine College
Due West, SC 29639

49. Robert D. Sutter
N.C. Dept. of Agriculture
Pest and Plant Protection
P.O. Box 27627
Raleigh, NC 27611

50. Richard Thomas
Department of Biology
Western Carolina University
Cullowhee, NC 28723

51. Karen Wade
Appalachian Trall Project Off.
Harpers Ferr, WV 25425

52. John Warden
Biology Department
East Tennessee State University
Johnson City, TN 37601

53. Alan Weakley
Department of Botany
Duke University
Durham, NC 27706

54. Dr. Peter White
National Park Service
Uplands Field Research Lab.
Rt. 2, Twin Creek Area
Gatlinburg, TN 37738